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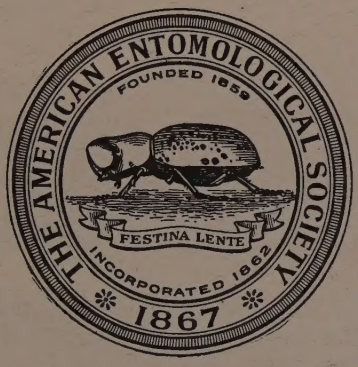

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TRANSACTIONS

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VOLUME LXIX

THE SPECIES OF THE TRIBE ILYTHEINI (DIPTERA: EPHYDRIDAE: NOTIPHILINAE)

BY EZRA T. CRESSON, JR.

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(Plates I and II)

While working over the genus *Ilythea* for my contemplated monograph of the North American Ephydridae, I found that it contained several groups of species which seemed to deserve nominal considerations. This lead me to study the species of other faunae that were before me and those already described which I have not seen. The facial characteristics are so marked, that it is doubtful if any of the species assigned to the genus were incorrectly placed, and in addition, the wings of most of the species have been figured, showing the characteristic maculation of the genus.

In this study I recognize three genera, two of which are considered new. Eighteen species are treated; one is doubtful, and three are described as new. Twelve of the known species I recognize in the material studied. This material, totalling over 400 specimens,[1] besides that portion already in the collection of The

[1] This number includes those from North American localities which are not noted in the present paper among the specimens examined. See footnote 4, page 7.

Issued April 29, 1943 1103.40

Academy of Natural Sciences of Philadelphia [A.N.S.P.], was sent to me for determination by a number of collectors and institutions, whose generosity and cooperation, have been appreciably acknowledged in many of my previous papers on this family. Among these may be mentioned the following: Dr. A. L. Melander [Mel.]; American Museum of Natural History [A.M.N.H.]; Illinois State Natural History Survey Division [I.N.H.S.]; University of Kansas [U.K.]; J. S. Hine Collection, Ohio State University [O.S.U.]; United States National Museum [U.S.N.M.]; Imperial Institute of Entomology, London [I.I.E.], types placed in the British Museum of Natural History [B.M.]; Instituto Oswaldo Cruz, Rio de Janeiro, through Dr. H. de Souza Lopes [I.O.C.]; Instituto de Biologia Vegetal, Rio de Janeiro, through Dr. T. Borgmeier [I.B.V.]. Vienna National Museum, through Dr. K. Zerny.

Tribe Ilytheini new tribe

A tribe of the Notiphilinae, the species of which are recognized by the extensive subhemispherical or semibulbous development of the face, and which has a more or less distinct, often denuded, tubercle at the lower extremity of the interfoveal carina, appearing in profile as a decided angle (Fig. 1). In all the known species excepting one which I have not seen, the wings are maculate. The characteristic facial development readily distinguishes the species of this tribe from all the other members of the Notiphilinae.

Tribal features.—Head large with large bare or micro-pilose eyes, the anterior orbits of which converge to, but not emarginated, slightly ventrad of line of the antennae; posterior orbits visible in profile. Frons transverse with areas not well marked except sometimes in contour; ocelli on weak tumor at vertex; postocellars well developed, close together, caudad of line of anterior ocellus. Frontals reclinate or somewhat lateroclinate; the somewhat smaller proclinate frontorbitals present. Lunule not developed. Face large, long, throwing antennae well above center-line of head and eyes; lower portion ample, very prominent, in profile, forming a distinct angle with the upper foveal portion, with sometimes a distinct tuberculose development at this angle (Fig. 1) at the ventral terminal of the interfoveal carina. Parafacies comparatively narrow. The series of mesally inclined facials present, of which the uppermost pair are more dorsally, the lower ones more ventrally, inclined; a secondary series of similarly inclined setulae. Buccal bristle present; postbucca not turgid. Mouth large and gaping, with narrow often invisible clypeus. Proboscis short, subbulbous at base, with small palpi. An-

tennae short; segment II sessile with dorsal seta but weakly developed lobe and spine; III subconical; arista with long hairs.

Thorax short, subglobose with fore coxae attaining base of mid coxae. Mesonotum quadrate, convex with strong dorsocentrals arranged 1:1 or 1:2; strong approximate prescutellars well cephalad and aligned with posterior intra-alars; no humeral, and weakly developed presutural; two notopleurals, postalar, mesopleural, and sternopleural, present; notopleurals short, the posterior bristle far removed dorsad from the ventral margin (Fig. 2). Scutellum convex with strong apicals and laterals.

Abdomen ovate to rotund; tergite V of male longer than IV; genitalia not conspicuous. Legs slender, not conspicuously setose. Wings usually strongly maculate; costa broken at humeral crossvein but not cleft at vein I, weakly setulose beyond vein I. Alula moderately broad, weakly ciliate.

This group contains mainly tropical species, the majority of which occur in the Western Hemisphere, and one ranging into Europe. Besides the genus *Ilythea* sens strict. two others constitute this tribe, and the characteristics of which will be described in their respective places. However, because of the comparative obscurity of their structural generic features, all the species are included in the one key. Those species not seen by me are included on the characters gleaned from their descriptions and figures of the wings, but in a few cases when the former is so brief or inconclusive, the species can be separated only by their known distribution.

Key to the Species of the Tribe Ilytheini

1. Wing maculation indistinct or wanting (Canary Islands). *Zeros? Ilythea nigricauda* Bigot (See also couplet 10.)
   Wing maculation distinct....2
2. Vein II long, subparallel to III; costal section II several times longer than III; submarginal long, narrow....11
   Vein II short, almost straight to costa, strongly divergent from III; costal section II at most but slightly longer than III; submarginal short (*Zeros* new genus)....3
3. Abdomen polished black, without any trace of vestiture except at most on ventral lobes and at apex; wing maculation in form of intervenous fuscous bars, and with but one isolated bar in marginal beyond tip of vein II; vein II straight to costa....*Zeros flavipes* (Williston)
   Abdomen more or less distinctly pruinose, which sometimes almost totally obscures the shining surfaces....4
4. Wing maculation consisting of relatively narrow fuscous intervenous bars, the hyaline interspaces but slightly suggesting rotundity in outline....8

Wing maculation typically, consisting of round hyaline intervenous spots in a fuscous field, the intervening fuscous areas rarely in form of parallel-sided bars.....5

5. Posterior crossvein wanting.....6
Posterior crossvein present.....7

6. American species.....*Zeros vicinus* new species
Seychelles Islands and African species.....*Zeros invenatus* (Lamb)

7. American species.....*Zeros calverti* (Cresson)
South African species.....*Zeros intermedius* new species

8. Posterior crossvein absent (Australia).....*Zeros defectus* (Malloch)
Posterior crossvein present.....9

9. Abdomen almost shining black (Seychelles Islands)
Zeros fractivirgatus (Lamb)
Abdomen distinctly pruinose, sometimes totally opaque.....10

10. Vein II straight to costa; maculation of wings sometimes almost obliterated but always bar-like; hyaline interspaces rectangular in shape; faint metallic violet or blue reflections on frons and mesonotum.
Zeros obscurus (Cresson)
Vein II undulating and curving into costa; wing maculation strong, the hyaline interspaces sometimes rotund; strong metallic violet or blue reflections on frons and mesonotum.....*Zeros fenestralis* (Cresson)

11. Two postsutural dorsocentrals present, but only one postsutural intra-alar; lateral scutellars about midway between apicals and base.
Donaceus nigronotatus new species
One postsutural dorsocentral and two postsutural intra-alars present; lateral scutellars basad (*Ilythea*).....12

12. Wing maculation as in figure 12 (Madeira Islands).
Ilythea nebulosa (Becker)
Wing maculation different; with three to four isolated fuscous spots in submarginal including the basal.....13

13. Legs including coxae and apices of tarsi, pale (North America).
Ilythea flaviceps Cresson
Legs for the most part, pale brown with femora distally and tibiae, pale; three fuscous spots in distal half of submarginal not including the one opposite posterior crossvein; face variegated with brown and gray or white; lighter mesonotal markings conspicuous (South America).
Ilythea niveoguttata Cresson
Ilythea cressoni Edwards
Coxae and femora black; at most two fuscous spots in distal half of submarginal.....14

14. Tibiae paler than femora, yellow to ferruginous, at most infuscated medianly; vestiture of face usually more or less cinereous.
Ilythea caniceps Cresson
Ilythea fusca Cresson
Tibiae black, at most narrowly pale apically; vestiture of face except foveae, brown.....*Ilythea spilota* (Curtis)

DONACEUS[2] new genus

The most distinguishing feature of this genus is the presence of the two posterior dorsocentrals, as well as the structure of the frons, and to some extent, the type of the wing maculation. The facial setation is similar to that of *Ilythea* sens str., but the long face and subhorizontal frons suggest species of *Zeros,* new genus here described.

GENOTYPE: *Donaceus nigrononatus* new species.

Head transverse in cephalic aspect. Frons almost horizontal in profile, uniformly flat, without any appreciable depression medianly, nor with median longitudinal sulcus; vertex sharp. Postocellars situated between the posterior ocelli; inner and outer verticals in almost transverse alignment, the inner scarcely more cephalad than the outer. Face very prominent in profile, particularly at epistomal margin, with about three strong facials. Acrostichals strong; dorsocentrals arranged 1:2; a few setulae cephalad of the strong intra-alars, which latter are aligned with the strong prescutellar pair. Scutellum very convex, with laterals strong and well removed apical. The type of wing maculation is clear rounded spots in a fuscous field; venation normal, with long second vein.

Species of the genus.—But one, the following species, is yet known belonging to the genus.

Donaceus nigronotatus new species (Pl. II, figs. 8 and 9.)

A rather pale species as regards the ground color, the two apical spots on the scutellum and the abdomen only, are black.

The ochraceous vestiture is not dense enough to completely obscure the shining surfaces which latter have no distinct metallic reflections. The vestiture of the mesonotum is variegated with brownish spots at bases of the setae. Scutellum with two large conspicuous subapical black spots between the apicals and the laterals. Vestiture of abdomen grayish mixed with brownish; of the face it is rather golden. Wing maculation as figured (Fig. 9).

General setation strong. Head in profile as figured (Fig. 8). Frons more than twice as broad as long; orbits not noticeably converging until slightly below antennae where the width of face is slightly less than one-half width of head. Face in cephalic aspect very broad at oral margin, almost as broad as head.

Length, 2 mm.

Type.—Female; Takao, Formosa; May 3, 1907; (H. Sauter); (A.N.S.P., no. 6650).

Paratypes.—1 ♂; with same data as for type.

[2] δονακευς, a thicket of reeds, alluding to the setose mesonotum.

A female from Tainan, Formosa, February, 1909, (H. Sauter), lacks the black scutellar spots, and the wing maculation is slightly more numerous, but otherwise, considering the imperfect condition of the specimen, it is similar to the type series.

ILYTHEA Haliday

1839. Haliday, An. Nat. Hist., III, p. 408.

The salient feature of this genus, as far as its species are known to me, is the long second vein which parallels the costa and enters the latter rather abruptly. Although the type of maculation is approached by several of the species of the following genus, it does not show such extreme variation as is found in the latter.

Frons rather uniformly, slightly convex, without any median preocellar sulcus, characteristic of *Zeros*, but has a slightly impressed line separating the meso- and parafrons. Vertex not sharp; occiput concaved. Face moderately long in profile, the angle not above center-line of eyes; the interfoveal carina prominent, forming a nose-like prominence, terminating in a rather distinct, sometimes denuded tubercle; facials long and strong, the series sometimes extending ventrad of line of buccal orbits. Acrostichals, four to five pairs, are rather well developed; dorsocentrals 1:1, a second intra-alar near suture. Wings with long vein II, making costal section II more than twice as long as III; ultimate of IV almost attaining inferior margin; maculation consisting of rather regularly arranged fuscous spots, some of the interspaces of which, in certain reflecting angles, appear as niveous spots in a fuscous field.

GENOTYPE: *Ephydra spilota* Curtis, 1832. (By monotypy.)

Species of the genus.—I retain five species in this genus; all tropical except *spilota* which occurs in North America and Europe. Of this five only one, *nebulosa* Becker, is unknown to me, and that one is considered merely on the type of venation and maculation, the latter being quite unique but of the same general type for the genus.

Ilythea spilota (Curtis) (Pl. I, figs. 1, 2, 3.)

1832. *Ephydra spilota* Curtis, Brit. Entom., II, p. 413, fig.
1839. *Ilythea spilota,* Haliday, An. Nat. Hist., III, p. 408.
1844. *Epipela notata* Stenhammar, Handl. K. Svenska Vet.-Akad., 1843, p. 186, pl. 4, fig. 8. (Syn. by Haliday, 1856.)
1856. *Ilythea spilota,* Haliday, Ins. Brit., III, p. 345.
1864. *Ilythea spilota,* Loew, Amer. Jour. Sci. & Arts, XXXVII, pp. 318, 322.
1878. *Ilythea spilota,* Osten Sacken, Cat. Dipt. No. Amer., (2), p. 204. (Syn.? *Ephydra oscitans* Walker, 1858.)

1896. *Ilythea spilota,* Becker, Berl. Ent. Zeit., XLI, p. 133, pl. 4, fig. 27, pl. 5, fig. 15.
1926. *Ilythea spilota,* Becker, Lindner, Fl. Pal. Reg., fam. 56, p. 28, figs. 39.

This appears to be the most common species of the tribe, and is easily recognized by the characters already given in the key. The pollinose vestiture often assumes a golden brown color and becomes quite dense on the frons and mesonotum, while on the other hand these areas may be nearly destitute of vestiture, fully exposing the shining surface. The face although normally uniformly brown, may also show considerable variation, particularly in some individuals from western United States which have considerable cinereous markings, and which strongly suggest *caniceps.* The wing maculation often becomes very faint particularly towards the inferior margin, while the spots between veins III, IV and V, although generally of hour-glass form, often break up into small spots.

Pale, yellow to ferruginous: knees, apices of tibiae, and tarsi except apices; rarely are the articulations of the antennae and of the legs, pale. Halteres pale, yellowish.

Opaque to semishining; the shining surfaces show in slight metallic reflections, more or less obscured by brown to ochraceous pollen, which may be sparse on the mesonotum, scutellum and abdomen; the abdominal vestiture is generally more grayish, and that on the face is lighter than on frons and quite dense, but the facial tubercle is generally denuded at tip; the foveae and narrow parafacies sometimes whitish. Wings with numerous fuscous, rather rectangular spots which are more dense along costa (Fig. 3), the submarginal cell always with a basal and three distal spots, the two median, often broken into smaller spots; the hyaline interspaces in reflected light generally appear niveous.

Structurally as described for the genus. Profile of the head as in figure 1. Length, 2 to 3 mm.

Distribution.—The species was originally described from England and, as far as known, occurs in the British Islands, Eastern, Central and Northern Europe and North America. In 1858, Walker [3] described *Ephydra oscitans* from the United States, and Osten Sacken (1878) suspected it to be *spilota.*

Specimens examined: [4] 7. [All Coll. Vienna National Museum.]

[3] Trans. Ent. Soc. London, (n.s.), IV, p. 233.
[4] As the distribution of the species in North America will later be given in detail, this is not given here, nor included in the number of specimens examined.

GERMANY: Schildhorn, Berlin, X 7; Dorpat; "Alte Sammlung, det. Schiner."
AUSTRIA: Hammern, VII 17, (Mik).
BOHEMIA: Zettwing, I 9, (Mik).

Ilythea caniceps Cresson

1918. *Ilythea caniceps* Cresson, Trans. Amer. Ent. Soc., XLIV, p. 50.

This is apparently the Neotropical representative of the northern *spilota,* differing in its cinereous to niveous face; the paler maculation of the mesonotum being rather cinereous than ochraceous; tibiae entirely ferruginous, at most somewhat infuscated medianly.

Similar to *spilota* but more extensively paler, particularly the articulations of the antennae and femora, and the tibiae are entirely so except sometimes median infuscation. The vestiture of the mesonotum generally shows some ochraceous (rarely cinereous) markings at anterior margin, on humeri, notopleura and postalar regions; none at caudal margin in the dorsocentral series. The face excluding carina, but including cheeks and postbuccae, cinereous to niveous but this color may be confined to the foveae and the median area between the upper facials. Wing venation and maculation as in *spilota* (Fig. 3).

Length, 2 to 2.3 mm.

Distribution.—As ar as known to me, this species occurs in Costa Rica and the western portion of the United States, and will probably be found in Mexico.

Specimens examined: ♂ 11.

Cartago, V 17, 25, (P. P. Calvert; along ditch), [A.N.S.P., ♂ *type,* 1 ♂, 2 ♀, *paratypes,* and 1 ♂, 5 ♀, *topotypes*]. Southern slope of Irazú, near road to crater, VI 15, (P. P. Calvert), [A.N.S.P., 1].

Ilythea flaviceps Cresson

1916. *Ilythea flaviceps* Cresson, Entom. News, XXVIII, p. 147.

A very pale species having the proboscis and legs including coxae, entirely yellow. The wing maculation is quite dense.

Pale, yellow: Antennae except superior margin of III, ground of face and cheeks, mouthparts and legs including coxae and apices of tarsi. Halteres pale.

Frons, mesonotum, scutellum and mesopleura, rather densely yellow pollinose; face, occiput, sternopleura, metanotum and abdomen, cinereous to niveous. Vestiture not dense enough to fully obscure the shining surfaces of mesonotum and scutellum, which have some metallic reflections.

Wing venation as in *spilota,* but submarginal has five isolated fuscous spots, and the first posterior has four beyond posterior crossvein. However,

these cells, in reflected light, show three isolated niveous spots beside those at the apices and bases, as in *spilota.*

Structurally similar to *spilota* but the arista has seven to eight hairs.

Distribution.—Known only from the type series of two females from Bill Williams Fork, Mohave County, Arizona; VIII, (E. H. Snow); [type; University of Kansas].

Ilythea fusca Cresson

1931. *Ilythea fusca* Cresson, Dipt. Pat. & South Chile, VI, p. 99, fig. 21a.

This is probably the more southern and darker form of *caniceps,* and of which I have seen only the following, from Chile:

Angol, IX 24, [U.S.N.M., 1 ♂]. Puella, Prov. Llanquihue, [B.M., ♂, type].

Ilythea niveoguttata Cresson

1931. *Ilythea niveoguttata* Cresson, Dipt. Pat. & South Chile, VI, p. 99, fig. 21b.

The wing maculation in this species is more complicated than in the *spilota-caniceps* group, with three instead of two fuscous spots in the distal half of the submarginal; the spot at end of first vein is larger, more intense, and extends to third vein; and those in the basad portion of submarginal sometimes occupy the entire width of the cell. As compared otherwise with *caniceps,* the face is more variegated with brown; the cinereous maculation on the mesonotum more pronounced; the pleura less cinereous.

Distribution.—Known only by the female type from Puerto Varas, Prov. Llanquihue, Chile, [B.M.].

Ilythea cressoni Edwards

1933. *Ilythea cressoni* Edwards, Dipt. Pat. & South Chile, VI, p. 118.

A large species, very similar to *niveoguttata,* described from two males, Bariloche, at Lake Nahuel Haupi, Rio Negro, Argentina [type, B.M.]; and is not improbable the male of that species. Its most distinguishing character seems to be the "fringe of close-set transparent scales on the labella" which might be merely a secondary sexual feature. Otherwise there seems to be no noteworthy characters distinguishing it from *niveoguttata.*

Ilythea nebulosa Becker (Pl. II, fig. 12.)

1908. *Ilythea nebulosa* Becker, Mitt. Zool. Mus. Berlin, IV, p. 202, pl. 4, fig. 63.

1926. *Ilythea nebulosa* Becker, Lindner, Flieg. Pal. Reg., fam. 56, p. 28.

This species was described from the male sex from the Madeira Islands. The characteristic wing maculation (Fig. 12) is its most distinctive feature. I have not seen the species.

ZEROS[5] new genus

Although very similar to those of *Ilythea* in most respects, the species of the present genus have certain characteristics which cannot be ignored and which appear to be of generic significance. Even Williston[6] recognized that his *flavipes* "does not fully agree with the characters of *Ilythea* in the structure of the face" but evidently did not think such differentiation warranted the establishment of a new genus. He however placed his species in *Ilythea* with a query. In addition to the somewhat different face structure, there are other features which support the present treatment; among which are the following:

Similar to *Ilythea*. Wings shorter, with the short vein II usually divergent from III, making costal sections II and III more or less subequal in length; veins II to IV more or less sinuate, the latter very short beyond posterior crossvein. Frons with the vertex rather sharp and with a median longitudinal sulcus from anterior ocellus to lunular margin; ocellars are closed together. Face longer in profile, throwing the antennae dorsad, making the frons more horizontal, and the median angle of the former above center-line of eyes; medifacies larger and the facilia narrower, becoming linear ventrad, with only the minute setulae of the secondary series present on the lower portion of the facialia; the series of four to five hair-like facials being limited to the upper portion and the uppermost (the more dorsally inclined) bristle opposite the tuberosity; the latter, in the profile, sometimes reduced to a mere angle. Buccal bristle situated almost at the parafacies mesal margin. The anterior, sutural, intra-alar of *Ilythea* is absent. Scutellum broader, more semicircular. Wing maculation reduced, the fuscous spots becoming narrower, more transverse in shape, sometimes arranged in three almost complete facsiae across the wings.

GENOTYPE: *Ilythea obscura* Cresson, 1918.

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[5] Zeros, (♂), an unknown precious stone.

[6] Trans. Ent. Soc. London, 1896, p. 404, 1896.

Zeros calverti (Cresson) (Pl. I, fig. 4.)

1918. *Ilythea calverti* Cresson, Trans. Amer. Ent. Soc., XLIV, p. 51, (pl. 3, fig. 21. (Figure referred to *fenestralis* in error.)

This is evidently a peripheral species suggesting *spilota* in the wing maculation, having the clear spots much less in number.

Pale, yellow to ferruginous: antenna for the most part, sometimes ground of face, mouth parts, legs including coxae, and halteres.

Shining to polished, rather sparingly ochraceous pollinose on dorsal surfaces, becoming cinereous laterally. Mesonotum and scutellum with distinct metallic reflections. Face pale yellow sericeous on lower portion. Wing as figured (Fig. 4), sometimes with two smaller spots in apex of marginal instead of the large one.

Length, 1.5 mm.

Distribution.—A Neotropical species ranging northward into southern Florida. Originally described from Costa Rica.

Specimens examined: [4] 5.

COSTA RICA: On muddy beach of Rio Tempisque, Filadelfia, I 18, (P. P. Calvert), [A.N.S.P., ♀ *type*]. Along brook in woods near Juan Viñas, IV 28, (P. P. Calvert), [A.N.S.P., 1]. Higuito, San Mateo, (Pablo Schild), [U.S.N.M., 3].

Zeros intermedius new species (Pl. II, fig. 11.)

The wing maculation of this species is almost identical with that of the Neotropical *calverti* Cresson, and is very suggestive of that of *Ilythes invenata* Lamb from the Seychelles Islands, but of the more simple type, and that species is described as lacking the crossveins.

For the most part a dark species. Paler, yellowish: inferior portion of antenna II and III, oral portion of the face, knees and some tarsal segments. Halteres whitish. Wings as in figure 11.

Dorsal surfaces of head and thorax, the pleura, abdomen and legs, sparingly brown dusted. Face niveous, as are also some of the clear wing spots in certain aspects. Wings with clear, rather rotund spots in a fuscous field.

Structurally, normal for the genus, with the facial profile rather angular than tuberculous. Mesonotal setulae sparse and weak, the acrostichals not well developed.

Length, 1.8 mm.

Type.—Female; East London, Cape of Good Hope, Africa; July 19, 1924; (H. K. Munro); [Transvaal Museum Collection].

Zeros invenatus (Lamb) (Pl. II, fig. 10.)

1912. *Ilythea invenata* Lamb, Trans. Linn. Soc. London, Zool., xv, p. 322, fig. 12.

Probably a close associate of *intermedius* Cresson, which is rather substantiated by Lamb's statement the "Four specimens of this new species [*invenata*] . . . were sent by Mr. F. Muir from Durban." [7]

The following characteristics mentioned by the author, are the only ones which offer any help in its identification: Face dusting reddish, legs orange yellow with nearly black fore coxae. Crossveins absent. Wing maculation and venation as figured (Fig. 10).

Length, 1.25 mm.

Distribution.—The (type?) locality of the species is cited as "Seychelles. Mahé: marshes on costal plain, Anse aux Pins and Anse Royale, I. 1909." In addition the author stated that four specimens of this species were sent from Durban, but whether these were collected in South Africa or in the Seychelles, is not clear.

Zeros vicinus new species (Pl. I, fig. 5.)

In lacking the posterior crossvein [8] and in the similarity of the wing venation and maculation, this species is apparently related to *Ilythea invenata* Lamb, 1912, described from the Seychelles Islands.

Pale, yellow to ferruginous: antennae except dorsad, ground color of face ventrad, mouth parts, legs including coxae but excepting apices of tarsi, and halteres. Wings with venation and maculation as figured (Fig. 5).

Semishining, golden brown to ochraceous pollinose, with face, anterior margin of mesonotum and metanotum more cinereous. Abdomen black; the brown to cinereous vestiture but slightly obscuring the gloss; mesonotum with faint darker acrostichal and dorsocentral stripes; mesonotum and scutellum with distinct violet to blue reflections.

Structurally similar to *flavipes*. (No intra-alars are present on the type, but the scars are discernible.)

Type.—Female; Royal Palm Park, Florida; January 22, 1939; (A. L. Melander); [A.N.S.P., no. 6651].

Zeros fenestralis (Cresson) (Pl. I, fig. 6.)

1918. *Ilythea fenestralis* Cresson, Trans. Amer. Ent. Soc., xliv, p. 51.
1930. *Ilythea argyrostoma* Hendel, Konowia, ix, p. 144. (New synonymy.)
1931. *Ilythea fenestralis* Cresson, Dipt. Pat. & South Chile, vi, p. 99.
1938. *Ilythea fenestralis* Cresson, Rev. Entom. R. d. Janeiro, viii, p. 33.

[7] These specimens are said to be in the "Cambridge Collection."

[8] I do not consider the absence of the crossveins of generic importance. Besides *invenata*, another previously described species also lacks the posterior crossvein, i.e. *I. defecta* Malloch, 1925, of Australia, but in the wing maculation, that species simulates *flavipes* rather than *invenata*.

The wing maculation of this species is intermediate between that of *calverti* and *flavipes*. Here the hyaline spots or areas become larger, the fuscous areas reduced to transverse bars, strongly simulating the *flavipes* pattern; but there seems to be consistency in the undulating second vern which causes it to curve into the costa, and presence of the middle, isolated, fuscous spot in the marginal and the isolated spot in apex of the submarginal.[9] I cannot find any differentiating specific characteristics in Hendel's description of *argyrostoma* and must consider his species synonymous.

Pale, yellow to ferruginous: antennae for the most part, sometimes oral portion of face, legs including coxae, and halteres.

Shining on dorsal surfaces, but that of frons, thorax and scutellum with distinct violet to blue reflections; these surfaces somewhat obscured by brownish pollen, becoming cinereous laterally and on abdomen. Face niveous, sometimes with yellowish tone.

Structurally similar to *flavipes,* but cheeks somewhat narrower, about equalling antenna III in width. Wing venation and maculation as figured (Fig. 6). Vein II almost paralleling costa, with distinct undulation at the isolated spot in marginal, its tip distinctly curving into costa.

Length, 1.5 to 2 mm.

Distribution.—A Neotropical species, originally described from Cartago, Costa Rica. Previously recorded by me from the West Indies, Brazil and Uruguay, and as *argyrostoma* by Hendel, from Argentina; also occurs in Florida.

Specimens examined: [4] 25.

West Indies: Cuba—Soledad Cienfuegoe, I to II, (C. T. & P. P. Brues), [Mel, 3]. Puerto Rico—Aibonito, VI 1–3, [A.M.N.H., 1].

Costa Rica: Cartago, V 22, (P. P. Calvert; along ditch), [A.N.S.P., ♂ *type*]. Gúacimo, VI 6, (P. P. Calvert), [A.N.S.P., 12].

Panama: Monte Lirio, IV 6: Red Tank, IV 14: (All R. C. Shannon), [all U.S.N.M., 4]. Canal Zone—Pedro Miguel, IV 10, (R. C. Shannon), [U.S.N.M., 9].

Brazil: Federal District—Gavea, Rio de Janeiro, VI 29, (H. Souza Lopes), [I.O.C., 3]. Rio de Janeiro—Jussard, Angra, (Travassos et Lopes), [I.B.V., 1].

Uruguay: Montevideo, I 21–22, (F. W. Edwards), [B.M., 1]. Montevideo to Sallo & Concordio, Argentina, III 4–6, (H. L. Parker; at light, [U.S.N.M., 1].

[9] The figure given in the original reference is an error. It should have been referred to *calverti.*

Zeros obscurus (Cresson)

1918. *Ilythea obscura* Cresson, Trans. Amer. Ent. Soc., XLIV, p. 52.

This species has the true flavipes type of wing maculation, but the fuscous bars are sometimes almost indistinguishable. It is sometimes not readily separated from *fenestralis* when the truly bar-like maculated individuals of that species are encountered. However, in the present species the second vein is straight to costa as in *flavipes;* its whole length diverging from the third vein, not curving into the costa; the metallic reflections of the frons and mesonotum is generally absent. As compared with *flavipes,* the present species is more opaque, the brownish vestiture being denser, almost totalling obscuring the surface gloss; the vestiture of the abdomen is rather grayish and quite dense. The antennae and clypeus are for the most part or entirely dark.

Were it not for the density of the vestiture of the abdomen, this form might be considered a variety of *flavipes,* but this characteristic is very constant in the series examined.

Distribution.—A Neotropical species originally described from Costa Rica, and is also known from Guatemala; coming within the United States in Arizona and New Mexico.

Specimens examined: [4] 11.

GUATEMALA: Gualan, II 15, (J. S. Hine), [O.S.U., 5].

COSTA RICA: Rio Tempisque, Filadelfia, I 18, (P. P. Calvert; on muddy beach) [A.N.S.P., ♂ *type,* 2 ♂ *paratypes*]. Banana River near upper reservoir, XI 9, (P. P. Calvert), [A.N.S.P., 1]. Turrúcares, XII 22, (P. P. Calvert), [A.N.S.P., 2].

Zeros flavipes (Williston) (Pl. I, fig. 7.)

1896. ?*Ilythea flavipes* Williston, Trans. Ent. Soc. London, 1896, p. 403.
1897. *Ilythea flavipes* Williston, Kans. Univ. Quart., VI, p. 4.
1900. *Ilythea flavipes,* Coquillett, Proc. U. S. Nat. Mus., XXII, p. 260.
1918. *Ilythea flavipes,* Cresson, Trans. Amer. Ent. Soc., XLIV, p. 51, pl. 3, figs. 19 and 20.

A species easily recognized by the bar-like wing maculation (Fig. 7), and the polished black abdomen which latter is destitute of any vestiture except at apex in the females. Other distinguishing features of the wing maculation are the presence of a median isolated bar in the marginal, and the one in the submarginal beyond the tip of the second vein. The shining surfaces of the frons and thorax show very little if any metallic reflections, but the golden pollinif-

erous vestiture gives a bronze appearance, strongly contrasting with the polished black abdomen.

Dr. Williston was in doubt as to this species belonging to *Ilythea,* and if I were absolutely sure of my determination, although I feel that it is correct, I would have made this species the genotype of the present genus.

Distribution.—A Neotropical species ranging from Brazil northward into the United States. Originally described on two specimens from St. Vincent Island, West Indies; [type ♂ should be in the British Museum]. It has since been recorded from Brazil by Williston (1897); from Puerto Rico by Coquillett (1900) and from Costa Rica by Cresson (1918). I have seen the following Neotropical material:

Neotropical specimens examined: [4] 41.

CUBA: Guantánamo, XII, (H. Skinner), [A.N.S.P., 1]. Soledad, Cienfuegos, I to II, (C. T. & P. P. Brues), [U.S.N.M., 3].

JAMAICA: Battersea, II, (R. Thayer), [Mel, 5].

MEXICO: Tampico, XII 29, (from weeds), [I.N.H.S., 3].

COSTA RICA: Rio Tempisque, Filadelfia, I 18, (P. P. Calvert; on muddy beach), [A.N.S.P., 15].

PANAMA: Bella Vista, IV 3; Fort Clayton, IV 23; Red Tank, IV 14; Pedro Miguel, Canal Zone, IV 10; (all R. C. Shannon), [all U.S.N.M., 13].

BOLIVA: Rosario Lake, Rogagua, X 28–XI 9, (W. M. Mann), [U.S.N.M., 1].

Zeros defectus (Malloch)

1925. *Ilythea defecta* Malloch, Proc. Linn. New So. Wales, L, p. 327, fig. 12.

On the strength of the wing venation and maculation, this species is placed in the present genus. It is apparently very similar to the Neotropical *flavipes,* but is said to be lacking the posterior crossvein. Also, the figure of the head, in the original citation, shows an unusual arrangement of facial bristles, not typical for the genus.

Originally described, apparently on one female, from Eidsvold, Queensland, Australia. Probably in the Queensland Museum.

Zeros fractivirgatus (Lamb)

1912. *Ilythea fractivirgata* Lamb, Trans. Linn. Soc. London, Zool., XV, p. 321, fig. 11.

The wing maculation of this species is similar to that of *flavipes,* and there is nothing in the original description to definitely separate

the two species. However I do not consider them conspecific. The statement by Lamb that "the shining elongate central knob of the face does not extend so far down to the mouth margin," also suggests its relationship with *flavipes*. "The frons is shining, while the face, jowls and lower eye-margins are dusted with gray." Dorsum of the thorax and scutellum are blue black, slightly dusted. Legs all yellow, abdomen black and shining. Lengths, 1.25 mm.

Distribution.—Apparently this species has not been recorded since originally described from Mahé, Seychelles Islands. I have not seen it.

Zeros nigricaudus (Bigot)

1891. *Ilythea nigricauda* Bigot, Bull. Soc. Ent. France, XVI, p. 278.

A poorly described species that cannot be definitely assigned to any other genus. It is placed here on the authority of its author in referring it to *Ilythea*. Its evanescing wing maculation suggests the *flavipes* type, as I have seen in this genus only, anything like an extreme dilution of the maculation. The original description is here given.

"— Long.: 2 mill. Antennis et facie pallid fulvis; fronte, cinereo obscuro, in medio fusco univittata; thorace, cinerascente, lineis quinque fuscanis ornato, duabus intermediis angustioribus; scutello cinerascente; abdomine, obscure fusco, apice nigro nitido; halteribus pallide fulvis; pedibus ejusdem coloris, tarsis apice fuscis; alis fere hyalinis."

Distribution.—Originally described, and known only from the Canary Islands. The sex of the type is not stated, but it is probably in the Paris Museum.

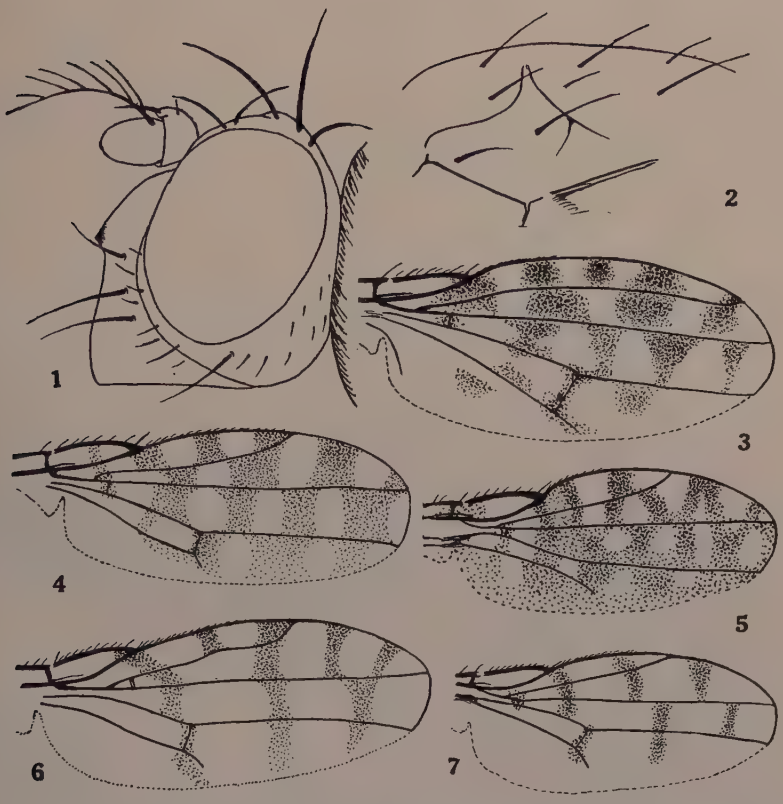

Fig. 1.—*Ilythea spilota* (Curtis). Head profile, (× 80). Fig. 2.—*Ilythea spilota.* Notopleura showing position of bristles, (× 80). Fig. 3.—*Ilythea spilota.* Wing, (× 20). Fig. 4.—*Zeros calverti* (Cresson). Wing, (× 20). Fig. 5.—*Zeros vicinus* new species, Wing (× 20). Fig. 6.—*Zeros fenestratus* (Cresson), Wing (× 20). Fig. 7.—*Zeros flavipes* (Williston), Wing (× 20).

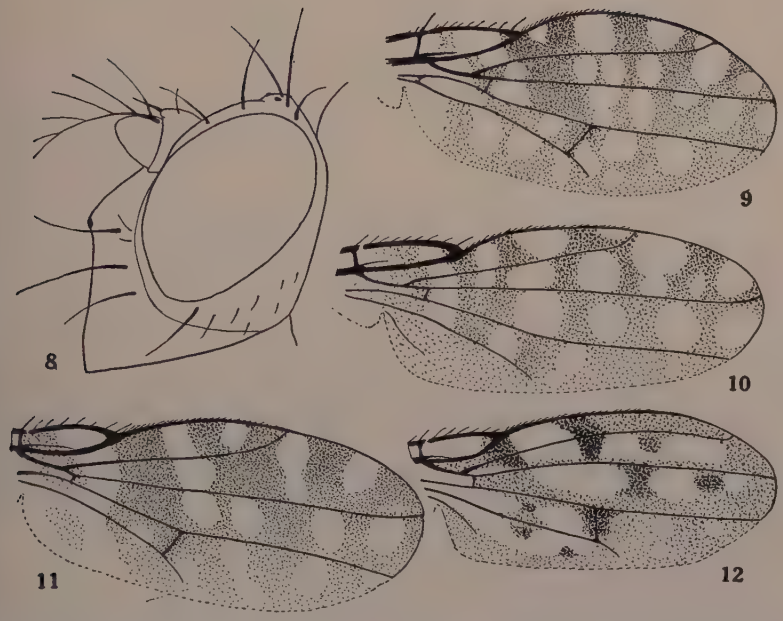

Fig. 8.—*Donaceus nigronotatus* new species. Head profile (× 60). Fig. 9.—*Donaceus nigronotatus* new species, Wing (× 25). Fig. 10.—*Zeros invenatus* (Lamb), Wing (× 25). Fig. 11.—*Zeros intermedius* new species, Wing (× 25). Fig. 12.—*Ilythea nebulosa* Becker. Wing reproduced from original figure.

THE SYNONYMY OF LIBELLULA AURIPENNIS BURMEISTER AND LIBELLULA JESSEANA WILLIAMSON, AND A DESCRIPTION OF A NEW SPECIES, LIBELLULA NEEDHAMI (ODONATA)*

BY MINTER J. WESTFALL, JR.

Cornell University, Ithaca, New York

(Plate III)

Over a period of several years the locally distributed and beautiful *Libellula jesseana,* with purplish body and reddish wings, has been taken in central Florida by the author and his associates, together with many specimens which were referred to *L. auripennis.* Mrs. Howard K. Gloyd has written that specimens of a light phase of *jesseana* had been confused with *auripennis* in a series of specimens sent to her. She indicated two or three characters which satisfactorily separated the two species in the collection at Rollins College. The writer became very much interested in the problem of determining the actual range and relative abundance of these two species. After her preliminary studies, Mrs. Gloyd suggested in a letter, October 3, 1941, that I work out this problem, and she pointed out the possibilities it held. This paper is the result of that study.

The material upon which this paper is based has been assembled through the help of the following persons: Nathan Banks, Museum of Comparative Zoology (M.C.Z.); C. S. Brimley, North Carolina State Department of Agriculture (N.C.D.A.); P. P. Calvert and E. G. Fisher, Academy of Natural Sciences of Philadelphia (A.N.S.P.); E. M. Davis, Thomas R. Baker Museum, Rollins

* This paper was presented for publication as the author was called to military service. Before it could be accepted for publication, certain rearrangement was necessary. It was not practical for the author to do this, but he empowered the Editor to do this for him. Nothing of the content has been changed, the same merely rearranged. This was carefully done and it is hoped that no errors have occurred. [Ed.]

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College (E.M.D.); F. M. Gaige and L. K. Gloyd, Museum of Zoology, University of Michigan (Williamson Collection—E.B.W.); B. E. Montgomery, Purdue University (B.E.M.); J. G. Needham, Cornell University (C.U.); workers at the United States National Museum (U.S.N.M.).

History

In 1839 Burmeister described *L. auripennis* in the typical, brief manner of the time. His type, now at the Museum of Comparative Zoology at Harvard, was probably brought to America by Hagen in 1870, according to a recent letter from Dr. P. P. Calvert. It is still in very good condition.

In 1842 Rambur described *L. costalis*. This species was then placed as a synonym of *auripennis* by Hagen in 1861, after a study of the types. Ris [1] also apparently studied the type of *costalis*, but Dr. Calvert informs me in a letter that he considers it unlikely that Ris ever saw the type of *auripennis*. Calvert further writes that he himself probably saw the type of *costalis* when De Selys showed him his collection, but that he made no notes on it.

In 1922 Williamson described a beautiful *Libellula* with scarlet wings and blue body as *L. jesseana*. The type series contained forty-four males and two females from what was called Figure-8 Pond near Enterprise, Florida. Mr. Williamson separated both sexes of *jesseana* from *auripennis* by the darker face and frons, and the darker dorsum of the thorax and abdomen. He also mentioned the more intense wing coloration posterior to vein R in *jesseana*.

Mr. Williamson offered no explanation of why the species had not been taken elsewhere, but concluded that it was hardly due to lack of collecting. He thought that it was restricted to the one pond and wondered how long it would be able to survive and if it would be able to extend its range.

Davis and Fluno [2] reported that *L. auripennis* is very abundant in the vicinity of Winter Park, Florida. They also recorded the capture there of many specimens of the purple-bodied *jesseana* during the summer of 1935.

[1] Coll. Zool. Selys Longchamps, Libel., fasc. 11, p. 274, 1910.
[2] Entom. News, XLIX, p. 45, 1938.

After checking the Williamson collection, Mrs. Gloyd wrote us that the two species had been confused by odonatologists, and that all of them had made misidentifications. We referred to the drawings of the penes of *auripennis* and *jesseana* by Kennedy,[3] and it seemed they might be different. The penis of the light phase of *jesseana* proved upon study to be the same as that of the purple-bodied specimens, and morphologically the adults are alike, differing only in the coloration of the wings and body. The stigma in the mature males of the light phase was just as much a "dragon-blood red" as that of the purple-bodied specimens, and the wings of many were quite reddish. This seemed to be a character almost good enough to separate *auripennis* and *jesseana* in the field.

Mrs. Gloyd called attention again, in a letter, to the distinct difference in the thoracic pattern of the two species, pointed out in the description of *jesseana* by Williamson. The individuals of the light phase, especially the females and tenereal males, showed the "two more or less distinct pale stripes, one just posterior to the humeral, and the others just posterior to the second lateral suture" as Williamson described them in the purple-bodied *jesseana*. In contrast to these two light lateral bands, our specimens which we referred to *auripennis* because of the different penis (the "hood" not showing as a definite projecting ridge) showed a single more or less distinct light band which ran forward from the pale postero-ventral region of the thorax, crossed the humeral suture anteriorly, to the lower anterior corner of the mesepisternum, covering the region of both supraepisternum and infraepisternum bordering the suture which separates them. (See figures 3 and 6.)

On the basis of these morphological characters some of the specimens in the collection of the Baker Museum, Rollins College, were redetermined as *jesseana* (yellow phase). It thus appeared that *jesseana* was the common species and *auripennis* the rare one near Winter Park, Florida.[4] In 1942 a number of specimens of *jesseana* were reported from Brevard, North Carolina, but only one specimen of *auripennis*, determined by Dr. Needham, which could not be located for rechecking.[5]

[3] Entom. News, XXXIII, pl. 4, figs. 18 and 16, 1938.
[4] Entom. News, LII, p. 17, 1941.
[5] Entom. News, LIII, p. 128, 1942.

Nathan Banks checked the type of *auripennis* for me, using a key which I sent to him. The specimens we had been referring to the light phase of *jesseana* proved to be conspecific with *auripennis*. Later I visited the Museum of Comparative Zoology and also studied the type of *auripennis*. It was apparent that the specimens we had been referring to this species represented another species.

Since no good morphological characters have been found to separate the purple-bodied specimens from the light phase which proved to be identical with Burnmeister's type of *auripennis, L. jesseana* Williamson must be considered a synonym of *L. auripennis* Burmeister. Mr. Williamson no doubt recognized the presence of these two species in Florida but unfortunately identified the type of *auripennis* with the new species described in this paper.

A long series of specimens has been studied, the data for most of them being listed below. It is noted that the purple-bodied specimens of *auripennis* have not been reported from the northern states, and that those we have taken in Florida near Winter Park were during the summers of 1935 and 1939. We looked for them during the intervening years and found none. All this time we were collecting specimens of the light phase, differing only in the lack of purplish bodies and the less intense reddish color of the wings. Hubbell and Friauf collected several specimens of this phase in Marion County, Florida, in 1938. In a letter from H. F. Strohecker to Mrs. Gloyd, Strohecker gives the data for three males of *L. jesseana* now in the collection of Emory University. He identified them from Needham's Handbook so they must have been of the purple phase. I have not seen them but the data is given here: 1 ♂, Daytona Beach, Florida, August 19, 1930; 1 ♂, Macon, Georgia, June 12, 1930; and 1 ♂, Charlton County, Georgia, May 8, 1933. This would extend the range of the purple form farther north. It is our opinion that difference of color like this alone is not enough to warrant specific rank.

Some have proposed old age and resulting pruinosity with which we are familiar in other species, as an explanation of the purple-bodied specimens. However, no purple-bodied specimens have

been reported from farther north and they must become just as old there. Furthermore we have purple-bodied specimens which are quite teneral with very shiny wings. Other specimens with the wings dull and ragged show no signs of this purplish color. The explanation must be sought elsewhere. Mrs. Gloyd, in a letter, suggests that the dark color might be due to some kind of "secondary melanism." It is possible that weather conditions, temperature and depth of water, the acidity of the water, or other environmental conditions might cause this color, but why they are not duplicated more often or elsewhere is not known. It is very likely that if we knew the ecological factors involved we could produce these two color phases at will. I have reared the light phase, but have not reared the dark phase, nor have I reared the nymph of the new species described in this paper.

We then questioned the true identity of the other species we had been calling *L. auripennis,* so we studied it to see if this might not be Rambur's *costalis.* His description of this species is somewhat better than Burmeister's description of *auripennis.* Many of the characters employed could be applied to either species. However, in describing the thorax Rambur wrote (translation), "thorax pinkish, having the inter-alar space, an anterior line and two lateral bands yellow, more or less conspicuous," thus using almost exactly the same words as Williamson used in describing *jesseana.* It is difficult to see how he could have interpreted the thorax of the questionable species in this way. The metathoracic tibiae were described as dark pink and the tarsi blackish which does not correspond exactly with our key for separating the species, although I have seen a few dried specimens in which the metathoracic tibiae were not as dark as in most specimens. Such a specimen is a male from Aiken County, South Carolina. The type of *auripennis* from Savannah, Georgia, does not have the legs quite as dark as in most specimens I have seen, but distinctly darker than in the questionable species. The amount of reddish in the wings also varies, and in the females of *auripennis,* as well as in some males, there is a region along the costa which is distinctly darker colored. Our decision is that Rambur must have redescribed the true *auripennis* as *costalis.*

Key to Distinguish Species Discussed

Costa proximal to nodus distinctly darker than that part distal to it, the contrast being very definite at the nodus.
Legs almost uniformly light brown, sharply contrasting with the black tibial spines.
A transverse light band extending from the pale postero-ventral region of the thorax, crossing the humeral suture anteriorly, to the lower anterior corner of the mesepisternum.
The "hood" of the penis shows as scarcely a low ridge.
Stigma yellow to orange.....*L. needhami* new species
Costa proximal to nodus not distinctly darker than that part distal to it.
At least with metathoracic tibiae black, the tibial spines not contrasting with them.
Thorax with two more or less distinct pale stripes, one just posterior to the humeral, and the other just posterior to the second lateral suture.
The "hood" of the penis shows as a definite projecting ridge.
Stigma yellow to blood-red.....*L. aurippenis* Burmeister

Libellula (Holotania) needhami[6] new species (Pl. III, figs. 1, 2, 3.)
Libellila auripennis of authors in part, not of Burmeister, 1839.[7] Calvert, Trans. Amer. Ent. Soc., xx, p. 256, 1893. Entom. News, v, p. 244, 1894. Davis, Jour. N. York Ent. Soc., vi, p. 197, 1898. Calvert, in Smith's Ins. N. Jersey, (Suppl., 27th. Ann. Rept. Sta. [N. J.], Bd. Agr.), p. 73, 1900. Needham, N. York Mus. Bull., no. 47, p. 532, 1901. Calvert, Entom. News, xiv, p. 220, 1903. Needham, N. York Mus. Bull., no. 68, p. 273, 1903, (under *L. axillena* supposition). Ris, Entom. News, xiv, p. 217, 1903. Brimley & Sherman, Entom. News, xv, p. 101, 1904. Calvert, Occ. Pap. Boston Soc. Nat. Hist., vii, p. 33, 1905. Brimley, Entom. News, xvii, p. 84, 1906. Daecke, Entom. News, xix, p. 441, 1908. Ris, Coll. Zool. Selys Longchamps, Libel., fasc. 11, p. 273, fig. 156, 1910. Davis, Jour. N. York Ent. Soc., xxi, p. 24, 1913. Brimley, Entom. News, xxix, p. 229, 1918. Howe, Psyche, xxv, p. 110, 1918; Psyche, xxvi, p. 67, 1919; Psyche, xxvii, p. 58, 1920; Mem. Thoreau Mus. Nat. Hist., ii, p. 69, fig., 1920. Kennedy, Entom. News, xxxiii, p. 71, pl. 4, fig. 18; and p. 106, 1922. Garman, Conn. Geol. Nat. Hist. Surv., Bull. no. 39, (Odonata or Dragonf. of Conn.), p. 343, 1927. Needham, Cornell Univ. Mem. no. 101, p. 54, 1928. Needham & Heywood, Handb. Dragonf. No. Amer., p. 222, 1929. Byers, Univ. Florida Pub., Biol. Ser., i, (1), p. 107, 1930. Davis & Fluno, Entom. News, xlix, p. 45, 1938. Brimley, Insects No. Car., p. 39, 1938. Fisher, Entom. News, li, p. 42, 1940. Westfall, Entom. News, lii, p. 17, 1941; liii, p. 128, 1942.

[6] Named for Dr. James G. Needham, from whom I have received much inspiration and assistance in my study of the Odonata.

[7] The bibliography given is chosen from one much longer. These references to *auripennis* we believe should apply at least in part to *L. needhami*. In many cases specimens upon which the records were based have been examined in this study.

Male: Total length, 53–56; abdomen with appendages, 35–38; hind wing, 39–41; stigma, front wing, 6–6.5 mm.

Labium yellowish brown; labrum reddish; anteclypeus greenish brown; postclypeus, frons, and frontal vesicle yellowish to reddish; antennae and adjacent area dark brown or black; occiput brownish; rear of head yellowish brown.

Dorsum of pterothorax brown, yellowish between the wing bases, and with a lighter line on the dorsal carina; a transverse light band extending from the pale postero-ventral region of the thorax, crossing the humeral suture anteriorly, to the lower anterior corner of the mesepisternum, covering the area of both supraepisternum and infraepisternum bordering the suture between them; metathoracic spiracle quite heavily margined with black.

Abdomen slender; yellowish to reddish brown dorsally, with a dorsal black stripe which becomes almost obscure on the proximal segments; teeth on lateral black; distal segments darker; sterna brownish with a pair of black spots toward the distal end of segments three to eight quite noticeable, not so evident in younger specimens; appendages yellowish to reddish brown.

Legs light brown with a reddish tinge the spines black; wings hyaline except for a narrow anterior band which is yellowish to reddish; costa, subcosta, radius, and M_1 in both wings yellowish to reddish orange, the costa proximal to the nodus much darker than the portion from the nodus to the stigma; most of the other veins dark brown to black; stigma yellow to orange, bordered anteriorly and posteriorly by black veins; wings slightly tinged with brownish distally. Antenodals, front wing, 16–17; hind wing, 11–15; postnodals, front wing, 11–16; hind wing, 10–15. Penis with the "hood" showing as scarcely a low ridge. (See figures 1 and 2.)

Female: Total length, 52–56; abdomen with appendages 36–38; hind wing, 39–41; stigma, front wing, 6–6.5 mm.

Similar to male, but with clypeus, frons, and frontal vesicle greenish brown; labrum with a tinge of orange, and top of frons usually with two yellowish spots; anterior border of wings yellowish, as well as the veins from costa to M_1; contract between color of costa proximal and distal to nodus usually sharper than in most males; wings distally are more noticeably tipped with brownish.

Holotype (male) and *allotype* (female).—Canal Point, Florida; April 21, 1941; (E. M. Davis), [Collection at Cornell University].

Paratypes.—(143 ♂, 148 ♀) as follows:

Alabama. Baldwin Co.: 5 miles east of Mobile, 3 ♂, 6 ♀, July 15, 1935, (I. J. Cantrall), [E.B.W.]; Daphne, 1 ♀, August 19, 1931, (A. L. Dietrich), [C.U.].

Connecticut. New Haven Co.: New Haven, 1 ♂, July 22, 1924, (J. L. Rogers), [B.E.M.]. Fairfield Co.: Fairfield, Wilson's Point, 1 ♂, (J. E. Benedict, Jr.), [U.S.N.M.].

DELAWARE. New Castle Co.: Delaware City, 4♂, 6♀, July 1, 1903, (Samuel N. Rhoads), [A.N.S.P.]. Sussex Co.: Rehoboth, 1♂, 2♀, June 22, 1903, (S. N. Rhoads), [A.N.S.P.].

DISTRICT OF COLUMBIA. Washington, 1♂, Ashmead, [U.S.N.M.]; 1♀, (J. S. Hine), [E.B.W.].

FLORIDA. Alachua Co.: 1♂, May 2, 1922, (T. W. Winter): Payne's Prairie, 1♀, June 24, 1935, (I. J. Cantrall), [E.B.W.]. Brevard Co.: Merritt's Island, near Titusville, 1♂, 2♀, April 28, 1940, (M. J. Westfall, Jr.): Titusville, 3♀, April 28, 1940, (E. M. Davis); Merrit's Island, near Titusville, 1♀, September 22, 1935, (J. A. Fluno), [E.M.D.]; Rockledge, 1♂, March, (S. E. Cassino): Haulover, 1♀, March 11, [M.C.Z.]; Lake Poinsett, 1♂, (Hubbard & Schwarz), [U.S.N.M.]. Broward Co.: 1♀, September 4, 1925, (T. H. Hubbell), [E.B.W.]; Ft. Lauderdale, 1♂, June 16, (Bates), [M.C.Z.]. Charlotte Co.: Punta Gorda, 2♂, 1♀, April 5 and 11, 1940, May 1, 1941, (Henry Ramstadt), [E.B.W.]. Collier Co.: 4 miles west of Immokalee, 2♀, April 15, 1941, (E. V. and Roy Komarek): Everglades, 1♂, April 5, 1912, (W. T. Davis): Marco Island, 1♂, 1♀, March 8, 1921, (J. H. Williamson), [E.B.W.]. Dade Co.: 2♂, 1♀, August 30, 1925, (T. H. Hubbell): Miami, 1♂, 1♀, April 12, 1921, (J. H. Williamson): Coconut Grove, 1♂, 1♀, March 4, 1933, (E. P. Breakey): Royal Palm Park, 1♀, April 17–19, 1936, (E. M. Davis), [E.B.W.]; Homestead, 1♂, (T. W. Young): Homestead, 1♀, July 26, 1940, (J. C. Bradley), [C.U.]; Royal Palm Park, 2♂, 1♀, April 17–18, 1936, (E. M. Davis), [E.M.D.]; Miami, 1♀, (J. E. Benedict, Jr.): Miami, 1♂, May 1901, (J. E. Benedict, Jr.): Miami, 1♀, March, (Dyar and Caudell): Miami, 1♂, 1♀, (H. C. Hendricksen): Miami Beach, 1♂, April 28, 1918, (T. E. Snyder): Miami, 3♂, 7♀, April 1898, (G. N. Collins): Miami, 1♂, April 1901, (J. E. Benedict, Jr.): Paradise Key, 1♂, 1♀, [C. A. Mosier Coll., through Dr. W. E. Stafford]; Paradise Key, 2♀, February 22–23, 1919, (A. Wetmore), [U.S.N.M.]; Royal Palm Park, 1♀, March 10–17, 1938, (E. P. Darlington): Miami, 1♀, February 20, 1901, (P. Laurent): Miami, 1♂, March 11, 1901, (P. Laurent), [A.N.S.P.]; Homestead, 1♂, June 20, 1930, (C. F. Byers), [B.E.M.]. Escambia Co.: Ft. Barrancas, 2♀, June 7, 1924, (C. F. Byers), [E.B.W.]. Franklin Co.: Apalachicola, 3♀, June 21–23, (J. C. Bradley), [C.U.]. Glades Co.: Palmdale, 1♂, April 4, 1921, (J. H. Williamson): Moore Haven, 1♂, March 29, 1921, (J. H. Williamson), [E.B.W.]; Palmdale, 1♂, April 5, 1921, (J. H. Williamson), [C.U.]; Palmdale, 2♂, April 6, 1921, (J. H. Williamson), [B.E.M.]. Hendry Co.: La Belle, 3♀, March 27, 1921, and May 8–10, (J. H. Williamson), [C.U.]; La Belle, 2♂, 3♀, March 26, 1921, (J. H. Williamson), [E.B.W.]. Martin Co.: Sewell Point, 1♂, 1♀, March 27, 1937, (Wm. Procter), [B.E.M.]. Monroe Co.: Cape Sable, 5♂, 3♀, April 12, 1941, (E. V. and Roy Komarek): Dry Tortugas, 1♂, June 9, 1931, (A. S. Pearse), [E.B.W.]; Key West, 2♂, (C. V. Riley), [U.S.N.M.]; Upper Matecumbe Key, 2♂, April 19, 1936, (E. M. Davis): Upper Matecumbe Key, 1♀, March 19, 1938, (M. J. Westfall, Jr.), [E.M.D.]. Orange Co.: Ocoee, 1♂, April 18, 1936, (D. F. Berry): Maitland, 1♂,

April 27, 1936, (E. M. Davis): Lake Apopka, 1 ♂, May 14, 1935, (D. F. Berry): Lake Apopka, 1 ♂, 1 ♀, June 15, 1935, (D. F. Berry): Ocoee, 1 ♂, April 17, 1936, (D. F. Berry): Ocoee, 1 ♀, April 20, 1936, (D. F. Berry): Winter Park, 1 ♂, August 8, 1935, (J. A. Fluno): Winter Park, 1 ♀, August 15, 1935, (J. A. Fluno), [E.M.D.]; Orlando, 3 ♀, June 7, 1942, (M. J. Westfall, Jr.), [M.J.W.,Jr.]. Osceolo Co.: Kissimmee Prairie, 1 ♂, March 22, 1938, (E. M. Davis), [E.M.D.]. Palm Beach Co.: Jupiter, 2 ♂, March 21, 1919, (T. Barbour): West Jupiter, 1 ♂, April 13, 1896, (C. B. Cory), [M.C.Z.]; Canal Point, 9 ♂, 9 ♀, April 21, 1941, (E. M. Davis), [E.M.D.]; Lake Worth, 1 ♂, May 30, 1936; Lake Worth, 2 ♀, March 5, 1936, (Springer), [B.E.M.]; Palm Beach, 1 ♂, 1 ♀, March 31, 1937, (C. B. Worth), [A.N.S.P.]. Pinellas Co.: St. Petersburg, 1 ♀, April 21, 1908, (L. A. Williamson), [E.B.W.]. Sarasota Co.: Sarasota, 1 ♂, 1 ♀, April 4, 1911, (L. A. Williamson), [E.B.W.]. Volusia Co.: Enterprise, 1 ♂, May 8, 1922: Enterprise, 1 ♂, April 23, 1921, (J. H. Williamson), [E.B.W.]; Enterprise, 1 ♂, May 17, (Hubbard & Schwarz), [U.S.N.M.]. Miscellaneous: Upper St. John's River, 1 ♂, July 1885, (H. G. Hubbard): Capron, 1 ♂, 2 ♀, (Hubbard & Schwarz): 1 ♂, (C. V. Riley Coll., W. H. Finn): 1 ♀, only a Florida label, [U.S.N.M.].

Georgia. Glynn Co.: St. Simon Island, 1 ♀, April 22–May 12, 1911, (J. C. Bradley), [C.U.].

Louisiana. Acadia Co.: Crowley, 1 ♂, July 24, 1911, (E. S. Tucker), [U.S.N.M.]. Calcasieu Co.: Lake Charles, 1 ♂, July 24, 1906, (J. D. Mitchell), [U.S.N.M.]; Vinton, 1 ♂, June 18, 1931, (L. K. Gloyd), [E.B.W.]. Cameron Co.: Johnson's Bayou, 1 ♂, (Schaum), [M.C.Z.]. East Baton Rouge Co.: Baton Rouge, 1 ♂, September 5, 1935, (H. K. Gloyd), [E.B.W.]. Jefferson (?) Co.: Orleans Parish, 8 miles from New Orleans, 1 ♂, 1 ♀, July 17, 1935, (I. J. Cantrall), [B.E.M.]; Orleans Parish, 3 ♂, 3 ♀, July 17, 1935, (I. J. Cantrall), [E.B.W.]; Orleans Parish, 2 ♂, 1 ♀, May 21, 1938, (Mike Wright), [E.B.W.]. Orleans Co.: New Orleans, 1 ♂, 1 ♀, June 9, 1923, (T. H. Hubbell), [B.E.M.]; New Orleans, 1 ♂, July, (O. S. Westcott), [A.N.S.P.]; New Orleans, 3 ♂, 3 ♀, June 9, 1923, (T. H. Hubbell), [E.B.W.]; New Orleans, 1 ♂, (Shufeldt), [U.S.N.M.]. St. Tammany Co.: St. Tammany Parish, 2 ♂, 1 ♀, 1935, (I. J. Cantrall), [E.B.W.].

Maryland. Anne Arundel Co.: Bay Ridge, 2 ♀, June 20, 1897, (J. S. Hine); Bay Ridge, 1 ♂, 2 ♀, June 3–18, 1899, (J. S. Hine), [E.B.W.]; N. Linthicum, 1 ♀, July 5, 1932, (E. G. Fisher): Baltimore, 1 ♂, July 5, 1932, (E. G. Fisher): Lakeshore, 1 ♂, 1 ♀, August 4, 1937, (E. G. Fisher): Ft. Armistead, Curtis Bay, 2 ♂, 2 ♀, June 19, 1938, (E. G. Fisher), [A.N.S.P.]; Pasadena, Blue Waters, 1 ♂, 1 ♀, August 11, 1929, [C.U.]; 1 ♂, (Uhler), [M.C.Z.]. Baltimore (?), Co.: Maxwell Point on Gunpowder River, 1 ♀, July 8, 1933, (E. G. Fisher), [A.N.S.P.]. Calvert Co.: Chesapeake Beach, 1 ♀, July 23, 1915, (V. Busck), [E.B.W.]. Frederick Co.: 1 ♀, [M.C.Z.]. Kent Co.: Near Chestertown, 1 ♀, August 16, 1899, (E. G. Vanatta): Rock Hall, East Neck Island, 1 ♀, August 1935, (E. G. Fisher), [A.N.S.P.]. 2 ♂, Hagen (det. as *L. costalis* by Uhler in 1858), [M.C.Z.].

MASSACHUSETTS. Barnstable Co.: Woods Hole, 1 ♂, August 1898, (C. L. Marlatt); Woods Hole, 1 ♂, 1 ♀, July 12 and 28, 1899, (J. E. Benedict, Jr.), [U.S.N.M.]; Woods Hole, 1 ♂, August 19, 1894, (P. P. Calvert), [A.N.S.P.]; Woods Hole, 1 ♀, July 12, 1903, (R. Osburn), [E.B.W.]; Provincetown, 1 ♂, July 22, 1877, [M.C.Z.]. Norfolk Co.: Wollaston, 1 ♂, June 21, 1896, (F. H. Sprague), [M.C.Z.]. Plymouth Co.: Wareham, 1 ♂, 2 ♀, (July 10, 1 ♀), (O. Bangs), [M.C.Z.].

MISSISSIPPI. Harrison Co.: Gulfport, 1 ♂, (Miss Unwin), [C.U.]. Jackson Co.: Ocean Springs, 1 ♂, 2 ♀, June 4, 1930, (A. L. Dietrich), [C.U.]; Ocean Springs, 1 ♀, June 22, 1930, (A. L. Dietrich), [E.B.W.].

NEW JERSEY. Cape May Co.: Tuckahoe, 1 ♀, July 21, 1892, [E.B.W.; Ex. Coll. P. C. Calvert]; Above Cape May Point, 1 ♀, July 12, 1903, (H. L. Viereck): Cape May, 10 ♂, 5 ♀, July and August 1933–1935, (Witmer Stone), [A.N.S.P.]; Cape May, Lily Lake, 2 ♂, August 10, 1930, (Henry Fox and B. E. Montgomery): Cape May, Salt Bay, 1 ♀, June 30, 1903, (H. L. Viereck), [B.E.M.]. Ocean Co.: Mantoloking, 1 ♀, July 16, 1920, (R. H. Howe, Jr.): Between Chadwick and Lavallette, 1 ♀, May 21, 1903, (H. L. Viereck), [B.E.M.]. 2 ♀, (Guex), [M.C.Z.].

NORTH CAROLINA. Brunswick Co.: Winnabow, 1 ♀, August 12, 1936, (D. L. Wray), [N.C.D.A.]. Carteret Co.: Beaufort, 1 ♂, June 9, 1903, (F. Sherman): Beaufort, 1 ♂, 1 ♀, June 11, 1903, (F. Sherman); [N.C.D.A.]. Craven Co.: Ellis Lake, 1 ♂, June 19–24, 1905, (C. S. Brimley), [E.B.W.]. Dare Co.: Cape Hatteras, 1 ♂, 1 ♀, August 1905, (C. S. Brimley), [E.B.W.]. Hyde Co.: Lake Mattamuskeet, 1 ♂, 1 ♀, May 28, 1938, (Wesley Clanton), [L. K. Gloyd]. New Hanover (?) Co.: Audubon Park, 2 ♂, 1 ♀, May 19, 1909, [E.B.W.].

RHODE ISLAND. New Port Co.: Block Island, 1 ♀, August 28, 1891, (A. P. Morse), [M.C.Z.]. Washington Co.: Watch Hill Pond, 1 ♂, August 17, 1899 [E.B.W.; Ex. Coll. P. P. Calvert].

TEXAS. Matagorda Co.: Matagorda, 2 ♀, May 25–26, 1907, (E. B. Williamson), [E.B.W.].

VIRGINIA. Arlington Co.: Arlington, 1 ♀, June 16, 1914, (A. W. J. Pomeroy), [U.S.N.M.]. Princess Anne Co.: Virginia Beach, 1 ♀, July 20, (C. L. Pollard), [U.S.N.M.]. Westmoreland Co.: Coles Point, 2 ♂, 1 ♀, June 25 and August 4, 1917, (J. E. Benedict, Jr.), [U.S.N.M.].

CUBA. 2 ♀, 1844, Gundlach, [M.C.Z.].

MEXICO. Altamira, Tamaulipas, 1 ♂, 1 ♀, June 23 and July 14, 1903, (M. E. Hoag); [E.B.W.; Ex. Coll. P. P. Calvert]; Altamira, Tamaulipas, 1 ♂, 1 ♀, June 30, 1903, (M. E. Hoag), [A.N.S.P.].

Libellula auripennis Burmeister (Pl. III, figs. 4, 5, 6.)

Libellula auripennis Burmeister, Handb. der Entom., II, p. 861, 1839. Hagen, Synop. Neur. No. Amer., p. 155, 1861. Calvert, Trans. Amer. Ent. Soc., XXV, p. 93, 1898. Williamson, Entom. News, XIV, p. 229, 1903; XXV, p. 450, 1914; XXXIV, p. 38, 1923. Howell, Jour. E. Mitchell. Sci. Soc., LV, p. 322, 1939.

Libellula costalis Rambur, Hist. Nat. Ins., Neur., p. 59, 1842.

Libellula jesseana Williamson, Entom. News, XXXIII, p. 13, 1922. Kennedy, Entom. News, XXXIII, p. 71, pl. 4, fig. 16; and p. 105, 1922. Needham & Heywood, Handb. Drangonfl. No. Amer., p. 223, 1929. Byers, Univ. Florida Pub., Biol. Ser., I, p. 114, 1930. Davis & Fluno, Entom. News, XLIX, p. 45, 1938. Westfall, Entom. News, LII, p. 17, 1941; Entom. News, LIII, p. 128, 1942.

Specimens examined: 420; 281 ♂, 139 ♀.

Dark Phase

FLORIDA. Marion Co.: Ocala National Forest, Frye's Pond, 9 ♂, July 27, 1938, (T. H. Hubbell and J. J. Friauf). Orange Co.: East side of Lake Apopka, 1 ♂, April 11, 1935; Maitland, 3 ♂, April 27, 1935; Windermere, 5 ♂, July 4 and 23, 1939; Winter Park, 35 ♂, April 11–September 10, 1939. Seminole Co.: 2 ♂, May 13, 1939; 4 ♂, June 3, 1939. Volusia Co.: Enterprise, 8 ♂, (paratypes of *Libellula jesseana*) April 22–26, 1921.

Light Phase

ALABAMA. Mobile Co.: Mobile, 1 ♀, June 16, 1929, (A. L. Dietrich), [C.U.].

FLORIDA. (153 ♂, 108 ♀, February 23 to October 3.) From following counties: Alachua, Baker, Brevard, Charlotte, Citrus, Columbia, Dade, De Soto, Escambia, Glades, Hernando, Hillsborough, Jefferson, Lake, Lee, Leon, Liberty, Madison, Marion, Manatee, Nassau, Orange, Osceola, Palm Beach, Pasco, Pinellas, Polk, Saint John's, Seminole, Volusia.

GEORGIA. (42 ♂, 20 ♀, May 15 to September 27.) Bacon, Charlton (Folkston), Chatham (Savannah), Decatur (Bainbridge), Glynn (Everett City), Jefferson (Louisville), Lee (Leesburg), McDuffie (Boneville), Okefenokee Swamp.

LOUISIANA. Acadia Co.: Crowley, 1 ♀, July 24, 1911, (E. S. Tucker), [U.S.N.M.]; Church Point, 1 ♀, June 18, 1931, (L. K. Gloyd): Livingston Parish, 1 ♂, May 23, 1939, (L. K. Gloyd), [E.B.W.]. St. Tammany Co.: St. Tammany Parish, 1 ♀, (I. J. Cantrall), [E.B.W.].

MASSACHUSETTS. Barnstable Co.: Hyannis, 1 ♂, July 28, 1941, (E. M. Davis, [M.J.W.,Jr.]. Plymouth Co.: Wareham, 2 ♂, 1 ♀, May 30, 1912, July 4 and 26, 1913, (O. Bangs), [M.C.Z.].

MISSISSIPPI. Calhoun Co.: Big Creek, 1 ♀, June 18, 1929, (A. L. Dietrich), [C.U.]. George Co.: Lucedale, 2 ♀, July 17 and 19, 1929, (A. L. Dietrich): Merrill, 1 ♀, June 15, 1929, (A.L.D.), [C.U.]. Perry Co.: New Augusta, 1 ♂, July 12, 1929, (A.L.D.), [C.U.].

MISSOURI. 1 ♂, March 29, (Bernard Gerhard), [E.B.W.].

NORTH CAROLINA. Craven Co.: Lake Ellis, 1 ♀, May 1907, [N.C.D.A.]. Dare Co.: Roanoke Island, 1 ♂, July 25, (C. L. Pollard), [U.S.N.M.]. Henderson Co.: Hendersonville, 2 ♂, June 13, 1940, (M. J. Westfall, Jr.), [M.J.W.,Jr.]. Macon Co.: Highlands, 1 ♀, August 22, 1932, (J. S. Rogers), [E.B.W.]. Pamlico Co.: Hobucken, 1 ♂, June 8, 1933, (D. L. Wray); Oriental, 2 ♂, July 9, 1933, (D. L. Wray), [N.C.D.A.]. Transylvania Co.: Brevard, 5 ♂, July 1, 1940, July 18 and August 1, 1941, June 29–30, 1942, (M. J. Westfall, Jr.), [M.J.W.,Jr.].

SOUTH CAROLINA. Aiken Co.: Wagener, 1 ♂, June 27–28, 1935, (L. Bordie), [E.B.W.].

TENNESSEE. Monteagle Co.: Monteagle, 1 ♂, August 2, 1918, (E. B. Williamson), [E.B.W.].

DISCUSSION

A number of constant differences have been noted through the study of the long series of specimens of *auripennis* and *needhami*. One of these is the color of the stigma. In the very teneral specimens of both species it may be some shade of yellow. In the older males of *auripennis* the stigma is blood-red, while it is more nearly an orange color in *needhami*.

The two spots of yellow on the back of the head pointed out by Williamson for *jesseana* are quite apparent in most specimens of *auripennis*, while in *needhami* two definite spots are not seen. Of course the drying in some cases makes this character of little or no value.

The color of the face varies in both species from a greenish yellow or orange in females and young males to reddish in the older males. The anteclypeus in dried specimens of both species often is not so red. The frontal vesicle in *needhami* may be entirely red, but in most specimens it is brownish, tipped with yellow, orange, or red.

The wing veins of the male *auripennis* are usually almost entirely reddish, although a basal area in the region of the anals is often composed of blackish veins. The costa and subcosta bordering the stigma anteriorly and posteriorly, and the hind wing margin are black in both species. In *needhami* the wing veins are usually

darker except for a light band along the anterior margin of the wings. Some specimens from North Carolina have the wings almost as red as in *auripennis*.

Dr. Needham has noted a venational difference between these two species which is surprisingly constant. Cells lying along the anal vein in the hind wing are referred to as paranals by Dr. Needham. In counting the number of paranals between A_2 and the base of the anal vein we found that in *needhami* there are usually four in each hind wing, while in *auripennis* we most often found only three. In determining how constant this character would prove to be I tabulated the results of examining fifty specimens of each species, choosing at random an equal number of males and females. The number of cells in each hind wing were counted and recorded as shown below. The results were as follows: *L. needhami*, 24 ♂ (4–4), 1 ♂ (3–3), 18 ♀ (4–4), 5 ♀ (4–3), 1 ♀ (4–5), 1 ♀ (3–3); *L. auripennis*, 12 ♂ (3–3), 6 ♂ (3–4), 7 ♂ (4–4), 18 ♀ (3–3), 5 ♀ (3–4), 2 ♀ (4–4).

Another good character is the dark costa of *needhami* proximal to the nodus which contrasts sharply with the lighter color distal to it. In a few specimens from Louisiana, North Carolina, and Alabama it is not so marked, but a single wing of one of these species can usually be identified by this character. In the purple-bodied *auripennis* the bases of most of the main veins are dark, but in the costa this extends no farther than half the distance from the base to the nodus, so that there is no distinct change at the nodus from dark to light. Usually in the female *auripennis* the radius is a dark vein in contrast to the costa, while in *needhami* females the costa proximal to the nodus is black, but the subcosta and radius are light in color.

The leg character is also quite good. The black tibial spines stand out in sharp contrast to the general warm brown of the legs in *needhami*. The mesothoracic and metathoracic legs may be almost jet black in *auripennis*, but usually the metathoracic leg will vary from a light brown or yellow at the base to black on the tibia and tarsus. The thoracic color pattern on fresh and well-dried specimens when once recognized is perhaps the best character, especially on the younger specimens and females.

Genitalia

After carefully studying the penes of a series of both *auripennis* and *needhami,* I find that the differences are quite pronounced and constant (see figures 1.2.4.5). The penis of *needhami* is much smaller than that of *auripennis.* The lateral lobes of *needhami* are much enlarged before the slender tips, while in *auripennis* these lobes are quite uniform throughout. The "hood" is much higher and differently shaped in *needhami.* Kennedy [8] refers to two lobes beneath the medial lobes in *jesseana* as possibly being homologous with the internal lobes of *Sympetrum.* On page 106, in same paper, he states that *jesseana* "is specialized in the curious supplementary lobe under the cornual base." These lobes are present in all specimens of *auripennis* examined, and they are also present in *needhami,* although not so large and conspicuous. They are attached firmly to the medial lobes except at the apex. My conclusions after studying Kennedy's figure of *auripennis* [9] is that he did not draw the penis of *needhami,* but of a light phase of the true *auripennis.* It was tilted a bit differently than the penis of *jesseana,* was perhaps a little more expanded, and the extra lobes figured in *jesseana* ventral to the medial lobes were overlooked; otherwise the drawings are of the same species, since *jesseana* is now considered a synonym of *auripennis.*

Summary

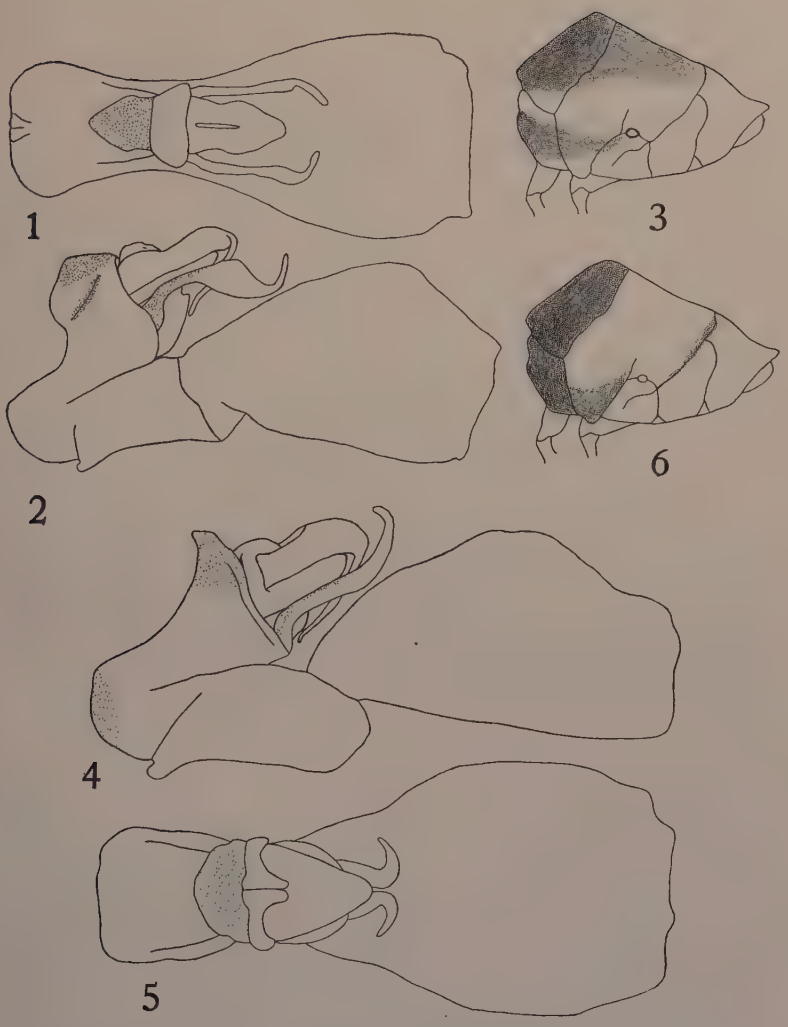
While looking through the various collections received I found that in several cases teneral or female specimens of *Libellula flavida* Rambur has been labelled as *auripennis.* When one is familiar with these species it is quite easy to separate *flavida* from *auripennis* and *needhami.* Besides the general body proportions and relative length of body and wings which give a clue to identity, there are several other differentiating characters that can be used. The thoracic pattern of *flavida* resembles that of *auripennis,* not *needhami.* The light color of the thorax laterally is bounded anteriorly by the humeral suture. The legs are more like those of *auripennis,* the tibiae being quite black. The color of the costa, however, is more like that of *needhami.* A teneral male shows the

[8] Entom. News, xxxiii, p. 35, pl. 3, figs. 26–27, 1922.
[9] Entom. News, xxxiii, pl. 4, 1922.

costa black to the nodus, lighter distally. The older females and males have the entire costa black.

Distribution of the Two Species

The distribution of the two species as indicated by the specimens examined is as follows: *L. needhami,* found especially in the Atlantic coastal region from Massachusetts to Florida, along the gulf coast to Mexico and Cuba; *L. auripennis,* in the coastal states from North Carolina to Louisiana, extending farther inland than the preceding species, being found in Tennessee and Missouri. It is also recorded from Massachusetts and probably extends from there southward in the coastal states.



Figs. 1 and 2.—*Libellula needhami* new species. Dorsal and lateral views of penis of male. Fig. 3.—*Libellula needhami* new species. Thoracic pattern. Figs. 4 and 5.—*Libellula auripennis* Burmeister. Dorsal and lateral views of penis of male. Fig. 6.—*Libellula auripennis* Burmeister. Thoracic pattern.

THE NORTH AMERICAN LOCUST GENUS PARATYLOTROPIDIA (ORTHOPTERA, ACRIDIDAE, CYRTACANTHACRIDINAE)

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Department of Insects, Academy of Natural Sciences of Philadelphia

(Plates IV and V and text-figures)

Since the description of its first known species in 1897 the genus *Paratylotropidia* has remained one of the most interesting and yet imperfectly known of the Nearctic members of the group Melanopli. Until quite recent years our information on its distribution and habits was exceeding fragmentary and disconnected and the material of the genus in all the collections of the country was very limited. In the last decade, thanks chiefly to the work of Professors Franklin Sherman, of Clemson College, South Carolina, and Robert L. King, of the State University of Iowa, our information has been very materially increased, and it is now possible to assemble a sufficient series of the genus to study its features, the specific components and their more evident variation and respective distributions.

The present study, undertaken with the cooperation of Professors Sherman and King, was partially completed several years ago, but for various reasons it was necessary to lay it aside at that time. The events of the present period make it desirable that studies of this character, on which considerable time has already been expended, be completed and published as promptly as practicable, rather than subjected to the delays which other studies, less near completion, will doubtless encounter through the exigencies of a war situation.

In this study we have examined 222 specimens, a considerable part of which we owe to the courtesy of Professors Sherman and King. We are also indebted to Mr. Herbert Knutson, of the

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University of Minnesota, Dr. C. S. Brimley, of Raleigh, North Carolina, and the authorities of the Museum of Comparative Zoology and of the United States National Museum for the loan of certain specimens here recorded. As usual the series contained in the Hebard Collection, deposited at the Academy of Natural Sciences of Philadelphia, has been at our disposal.

Certain field investigations made by us in 1939, which produced a portion of the material treated in this study, were aided by a grant from the Eldridge Reeves Johnson Fund of the American Philosophical Society.

PARATYLOTROPIDIA Scudder

1893. *Paratylotropidia* Brunner, Ann. Mus. Civ. Stor. Nat. Genova, XXXIII, p. 147. (Invalid, no type species described or properly indicated.)

1897. *Paratylotropidia* Scudder, Proc. Amer. Acad. Arts and Sciences, XXXII, pp. 201, 203. (Invalid, no type species described or properly indicated.)

1897. *Paratylotropidia* Scudder, Proc. U. S. Nat. Mus., XX, pp. 12, 117.

GENOTYPE (by indication of Scudder, 1897): *Paratylotropidia brunneri* Scudder.

History.—The genus *Paratylotropidia* was first very briefly and quite imperfectly characterized by Brunner in 1893,[1] without the valid indication of included species, the sole comment on this point being, "J'établis ce genre sur une belle espèce de grande taille qui me fut envoyée de Dallas au Texas." There is an honest difference of opinion as to whether such generic names can be accredited to an author who failed to cite as included in it a quotable (i.e. technically named) species, new or previously established, or instead should be cited from the first subsequent author who includes a quotable species, new or old, under that generic name. The present authors have already discussed a parallel case in the same work of Brunner, i.e. *Epeisactus,*[2] and they wish to reaffirm the conclusion, there set forth, that until included recognizable species are referring to it a generic name is not validly proposed. This attitude is the same as that followed by Blatchley in connection with *Paratylotropidia.*[3]

[1] "Révision du Système des Orthoptères," *Ann. Mus. Civ. Stor. Nat. Genova,* XXXIII, p. 147, (1893).

[2] Mem. Amer. Entom. Soc., no. 8, p. 21, (1934). The senior author also has recently discussed another parallel case in *Pseudostauronotus* Brunner (see Trans. Amer. Entom. Soc., LXVI, pp. 103–105, (1940)).

[3] Orth. N. E. Amer., p. 348 footnote, (1920).

In 1897 in a paper comprising a preliminary key to the genera of the Melanopli, Scudder included *Paratylotropidia,*[4] accrediting it to Brunner, as "based on an undescribed species found from Dakota to Texas." Later in the same year we find the first use of the generic name *Paratylotropidia* with a named included species, when Scudder, in his "Revision of the Melanopli," gave a full generic description,[5] as well as the description and figures of the single included species (*P. brunneri* Scudder). This latter was based on a male (figured) and a female, the former from "Dakota," the latter from Dallas, Texas. Both of these historic specimens are now before us. One group of Scudder's figures (i.e. fig. 5) consists of pencil sketches by Brunner of the male and female Dallas, Texas individuals in his collection, which served as the original background of the genus. Subsequent records of *P. brunneri* were, until recently, very few and far between, as it, like all the other species of the genus, is quite local in its occurrence.

In 1907 Morse described a second species of *Paratylotropidia* from North Carolina, as *P. beutenmuelleri.*[6] The type was a female, and it was not until 1932 that the male sex of the species was described and figured by Caudell[7] on the basis of an individual from the North Carolina side of the state boundary north of Rocky Bottom, South Carolina, received from Prof. Sherman. The above references comprise the basic taxonomic history of the genus and its previously described species.

Generic characters.—Body moderately stout, sometimes subcompressed (in *brunneri* and even more weakly in *morsei*). Surface in part variously cribroso-punctate, with very sparse and unevenly distributed brief pilosity.

Head, except for eye form in male of *P. beutenmuelleri,* with outlines converging to fastigio-facial angle, width across genae less than that across eyes, except in male of *P. beutenmuelleri* in which these dimensions are subequal; facial line moderately retreating, slightly arcuate to nearly straight; fastigio-facial angle rounded obtuse- to subrectangulate; fastigium as seen from dorsum ranging from broad to medium, its general transverse angulation obtuse, its lateral and cephalic margins rounded and obsolete to definite and carinate, the disk hardly or shallowly excavate caudad to the interocular area, which in width is greater than the dorsal breadth of the frontal costa; lateral foveolae not strongly fossulate, usually tumid, not

[4] Proc. Amer. Acad. Arts and Sciences, XXXII, pp. 201, 203, (1897).
[5] Proc. U. S. Nat. Mus., XX, pp. 12, 117, pl. IX, figs. 4 and 5, (1897).
[6] Psyche, XIV, p. 14, (1907).
[7] Proc. Entom. Soc. Wash., XXXIV, p. 86, fig., (1932).

marginally defined, cribroso-punctate, or deplanate (*beutenmuelleri* and ♂ of *morsei*), well defined by a carina dorsad and subfossulate: frontal costa broad to medium in width, not defined laterad to relatively well carinate (*beutenmuelleri*) in ventral half, surface non-sulcate and cribroso-punctate to appreciably sulcate and more weakly cribrose; supplementary facial carinae distinct but not strongly pronounced. Eyes not prominent except in male of *beutenmuelleri,* where they are more evident than in the other forms, subovoid in basal outline. Antennae slender, slightly longer than head and pronotum combined.

Pronotum ranging from relatively elongate and subequal in width, to broader, regularly widening caudad (in ♀ of *beutenmuelleri*), discal surface ranging from subdeplanate to subtumid (as an individual feature), this, when present, largely restricted to the prozona; lateral carinae marked on prozona, less decided but still apparent on the metazona, ranging from subparallel to subconvex or straight and diverging caudad, median carina well indicated throughout, except in *beutenmuelleri* where it is weak on the prozona; cephalic margin of disk subarcuate, caudal margin but faintly obtuse-angulate mesad; surface of metazona more decidedly cribroso-punctulate than that of prozona; latter longer than metazona; principal transverse sulcus impressed and complete, other sulci incompletely marked dorsad and not severing the median carinae; lateral lobes longer than deep, two sulci marked on lobes in addition to principal one, caudal margin obliquely sigmoid.

Tegmina abbreviate, acute to blunt lanceolate, ovoid or cycloid, usually definitely shorter than the pronotal disk, occasionally very slightly longer (in *brunneri*) and rarely in the macropterous phase (known only in *brunneri*) fully developed and reaching approximately to the caudal femoral apices; anal areas of tegmina overlapping dorsad or with the sutural margins merely contiguous; principal venation evident and well defined, secondary anastomosing venation complex but regular in size; marginal field broad. Wings rudimentary and concealed under the tegmina, or in the macropterous phase developed equally with the tegmina and having the venation relatively simple and unspecialized.

Prosternal spine relatively slender, cylindro-conic, slightly inclined caudad. Interspace between mesosternal lobes ranging from longer than broad to quadrate, always narrower than one of the lobes. Interspace between the metasternal lobes varying in width from definitely narrower to similarly broader than that of the frontal costa between the antennal bases.

Abdomen dorsad with a medio-longitudinal carina; tympana well developed, covered normally by tegmina. Male without furcula; supra-anal plate scutellate, elongate trigonal, longer than proximal width, apex rounded acute, lateral margins convexly converging distad, dorsal surface sulcate medio-longitudinally in proximal half, brief transverse carinate ridges present near lateral margins at proximal third of plate, most of surface subexcavate; cerci tapering, acute, reaching to or slightly surpassing tip of supra-anal plate, base relatively deep, apex weakly subfalcate; subgenital plate sub-

compressed dorsad, not ampliate, no distal tubercle present. Female with supra-anal plate scutellate, trigonal, apex sharply to bluntly acute, surface with a weak transverse median impression and a broken medio-longitudinal subsulcation; cerci short, acute, stout; dorsal ovipositor valves stouter than ventral pair, apices of both definitely but minutely cleft vertically; subgenital plate lanceolately acute produced distad between the bases of the ventral ovipositor valves, margin proximo-laterad with a distinct angulate shoulder.

Caudal femora relatively slender and elongate, paginal pattern regularly indicated; caudal tibiae usually with 10 to 11 external spines;[8] caudal tarsi with equal claws and well developed arolia.

Generic relationship.—Scudder in his sequence of the genera of the Melanopli placed *Paratylotropidia* next to and before *Melanoplus,* and until satisfactorily comprehensive studies of the relationship of the other components of the group demonstrate this to be incorrect, the position given by Scudder seems logical and warranted. Clearly *Paratylotropidia* possesses an unusual feature in the fissate tips of the female ovipositor valves, a very infrequent and distinctive character, doubtless correlated with some unknown angle of the oviposition of the species. Similarly the persistence of the lateral carinae of the pronotal disk is not of frequent occurrence in the Melanopli, but in a number of their most obvious features the forms of *Paratylotropidia* could be mistaken for brachypterous species of *Melanoplus,* and this is particularly true of *P. beutenmuelleri.* The infrequent presence of a macropterous condition is shared with a few normally brevialate species of *Melanoplus,* and with the genera *Dendrotettix, Podisma* (i.e. *P. pedestris*), *Oedaleonotus* and *Phoetaliotes,* but this in itself, in our opinion, is not indicative of close relationship. Doubtless similar activating factors are responsible, but intimate affinity does not necessarily follow.

Individual variations in pronotal width and inflation.—It is clearly evident from the considerable series of *P. brunneri* taken in a single area (Iowa County, Iowa), now before us, that marked individual variation exists in the female sex in the relative width of the whole pronotum and of the disk alone, and also in the extent to which the dorsum, and particularly of the prozona, may be bullate. We are presenting in figures 25 to 27 the extremes found in the females of this series. This variation in width of the

[8] Rarely by variation 8 or 12 may be present.

pronotum is also reflected in correlated variation in the width of the head across the genae.

The bullation of the dorsum of the pronotum is more unusual than variation in the pronotal breadth, which is not at all rare in certain genera. The dorsal bullation, however, is so pronounced it conveys a marked difference in the general facies, so much so that the two extreme types could readily be considered distinct species if evidence to the contrary was not before us. Whether the mechanism controlling the development of the more strongly bullate or inflated type is the same as that responsible for the bullate pronotal dorsum generally found in alpine male individuals of the western North American acridine *Aeropedellus clavatus,* remains to be determined.

In the male sex of *P. brunneri* there is some variation along the same lines as in the female, but this is very much less marked and by no means as obvious as in the opposite sex.

Dimorphism in wing length.—This condition was unnoticed until 1940, when King reported [9] seeing a considerable number of macropterous females of *P. brunneri* from Iowa. We have seen but five specimens of the genus with fully developed tegmina and wings, these all being females, taken as follows: Van Buren County, Iowa; September 1, 1937; (L. A. Spain), 1: Iowa County, Iowa; July 18 and 25 and August 1, 1937; (R. L. King), 4. The Van Buren County individual has been figured (see plate IV, fig. 24). In all, the tegmina reach to or even surpass the apices of the caudal femora, and are quite broad, the marginal field particularly so, as at its widest (proximal third of tegmen) it is but slightly narrower than the width of the whole remainder of the tegmen at the same point. The tegminal apices are well rounded, the venation as a whole more regular and less sinuate than usual in similar atavistic individuals. The last comment is also true of the wing venation. At a quick glance these macropterous specimens might be passed over as individuals of *Melanoplus bivittatus,* a superficial resemblance to which is heightened by the pale humeral lines which continue along the region of the anal vein of the tegmina to very near their apices. No macropterous males have as yet been reported.

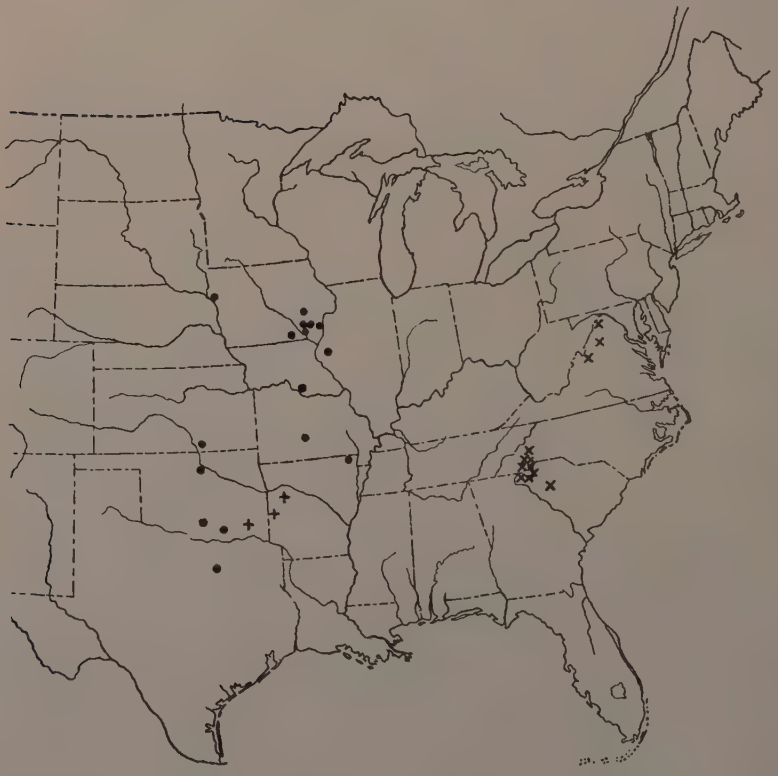
[9] Proc. Iowa Acad. Sci., XLVI, p. 418, (1940).

Distribution.—As far as known at the present time the genus has two centers of development, and as these, as far as at present known, are isolated, it has in consequence a discontinuous distribution. These centers are (1) the southern Appalachian area, and (2) parts of the western side of the Mississippi Valley and the prairie savanna between that region and the eastern edge of the Great Plains. The eastern area extends from the Blue Ridge and Alleghany Front of northern Virginia southwestward to the mountains and adjoining Piedmont of South Carolina. The western area extends from probably extreme southern South Dakota and northern Iowa southward to southern Oklahoma, northeastern Texas (Dallas) and south-central Arkansas, while east of the Mississippi River it touches western Illinois (Augusta). The eastern border of the Great Plains is presumably the western boundary of the range of the genus in Oklahoma, Kansas and probably in Nebraska and South Dakota, although we have no records from the former state and but a single general one from the latter. From the area between the eastern side of the main Alleghany Front in Virginia and the Black Mountain and Saluda Mountain areas in North Carolina on one hand, and the Mississippi River on the other, we have no records of *Paratylotropidia* except for the single one of *P. brunneri* from extreme western Illinois.

It is quite probable the distributional history of *Paratylotropidia* is somewhat akin to that of *Dendrotettix*[10] in that the discontinuity of its range indicates a reaction to Pleistocene conditions. The genus in late Pliocene or early Pleistocene times was probably more broadly and continuously distributed, and also the same factors which have isolated related species, or regional populations of the same species, as in genera such as *Zubovskya, Appalachia* and *Dendrotettix,* and in the panesthiid blattid *Cryptocercus,* have operated equally to separate the two major elements of the genus *Paratylotropidia.* The degree of difference between these two elements in the latter genus is, however, quite decided, and presumably their segregation dates back appreciably beyond that responsible for the other isolations above mentioned. As far as at present known *P. brunneri* occurs on no land surface which was

[10] See Rehn and Rehn, Trans. Amer. Entom. Soc., LXV, pp. 90–91, (1939).

covered by the Wisconsin glaciation, although its definitely known most northern points are not far distant from the moraine of the Wisconsin sheet.



Distribution of species of *Paratylotropidia* as shown by known exact records (i.e. exclusive of the "Dakota" record of *P. brunneri*). Dots represent localities for *P. brunneri*, vertical crosses for *P. morsei*, oblique crosses for *P. beutenmuelleri*.

Key to Species

1 Size smaller. Pronotum in both sexes proportionately broader; median carina of same low throughout and finely marked, occasionally wholly or partly obsolete on prozona; lateral carinae of pronotal disk finer and more sharply marked on prozona, regularly straight diverging caudad in both sexes. Tegmina very short and broad, in general outline broad ovate, distal margin broadly arcuate; venation densely and strongly anastomosing, principal longitudinal veins less evident. Ancorae or anterior processes [11] of the epiphallus of the concealed male genitalia more widely separated, more uncinate and shorter (see text-fig. 18). (Appalachian area from Virginia to South Carolina.)
beutenmuelleri Morse

Size larger. Pronotum in both sexes proportionately narrower; median carina of same marked and appreciably elevated on entire pronotum or at least on metazona; [12] lateral carinae of pronotal disk thicker and less sharply marked, less strongly diverging caudad and often bowed. Tegmina lanceolate or subovoid, distal extremity narrow, rounded or falcate; venation more open, less densely anastomosing, principal longitudinal veins more decided and more differentiated. Ancorae or anterior processes [11] of the epiphallus of the concealed male genitalia less widely separated, more spatulate and distinctly longer.....2

2. Tegmina definitely shorter than the dorsum of the pronotum, subovoid, their greatest breadth equal to two-thirds their length; distal extremity of tegmina narrowly rounded, not acute or falcate. Fastigium narrower as seen from dorsum. Cerci of the male, as seen in profile, with distal third more sharply narrowed. Ancorae or anterior processes [11] of the epiphallus of the concealed male genitalia closer to one another, slightly diverging distad (see text-fig. 17). (Ouachita region of west-central Arkansas and southeastern Oklahoma.)....*morsei* new species

Tegmina somewhat longer than the dorsum of the pronotum, lanceolate, their greatest breadth little, if any, more than half their length; [13] distal extremity of tegmina acute, almost always briefly falcate.[13] Fastigium broader as seen from dorsum. Cerci of the male, as seen in profile, throughout more evenly narrowing distad. Ancorae or anterior processes [11] of the epiphallus of the concealed male genitalia more definitely separated than in alternative, subparallel (see text-fig. 16). (Prairie regions from South Dakota, Iowa and Illinois to northern Texas and lowland Arkansas.).....*brunneri* Scudder

[11] See Roberts (Proc. Acad. Nat. Sci. Phila., XCIII, p. 241, (1941)) for the application of the term "ancorae." It is used for the paired lateral hook-like processes present dorso-cephalad on the epiphallus.

[12] In certain individuals with definitely more bullate pronota the prozonal section is less decided than that of the metazona.

[13] These limitations do not apply to the infrequent macropterous condition found in this species.

Paratylotropidia brunneri Scudder (Text-figs. 1, 4, 6, 9, 11, 13 and 16, plate IV, figs. 19–24, pl. V, figs. 25–27.)

1897. *Paratylotropidia brunneri* Scudder, Proc. U. S. Nat. Mus., xx, p. 118, pl. IX, figs. 4 and 5. [♂ (selected as single type by Rehn and Hebard[14]), ♀; "Dakota" (♂); Dallas, Texas (♀).]

1907. *Paratylotropidia brunneri* Morse, Carnegie Inst. Wash. Publ. no. 68, p. 46. (In part.) [Caddo Hill, Indian Territory (now Oklahoma).]

1931. *Paratylotropidia brunneri* Hebard, Proc. Acad. Nat. Sci. Phila., LXXXIII, p. 174. [♀; Cowley County, Kansas.]

1932. [*Paratylotropidia*] *bruneri* (sic) Caudell, Proc. Entom. Soc. Wash., XXXIV, p. 86.

1935. *Paratylotropidia brunneri* Knutson and Jaques, Proc. Iowa Acad. Sci., XLII, p. 182. [Des Moines County, Iowa.]

1937. *Paratylotropidia brunneri* Knutson, Field and Laboratory, v, p. 45. [Henry, Des Moines and Davis Counties, Iowa.]

1938. *Paratylotropidia brunneri* Blair and Hubbell, Amer. Midl. Naturalist, XX, p. 446. (In part.) [Osage Savanna district of Oklahoma.]

1938. *Paratylotropidia brunneri* Hebard, Okla. Agr. and Mech. Coll., Agr. Exp. Sta., Techn. Bull. no. 5, p. 20. [Sulphur, Oklahoma.]

1938. *Paratylotropidia brunneri* King and Beams, Journ. of Morphology, LXIII, p. 290. [Cytology, but including records from Lacey-Keosauqua State Park, Van Buren Co., Oakland Mills State Park, Henry Co., and Lake Wapello State Park, Davis Co., Iowa.]

1940. *Paratylotropidia brunneri* King, Proc. Iowa Acad. Sci., XLVI, p. 418. [Van Buren, Davis and Henry Counties, Iowa.]

This species, regarding which published information has been relatively fragmentary and quite spotty, is definitely a prairie-land type, crossing the Mississippi River, as far as known, only in western Illinois. While having an extensive north and south distribution it apparently does not enter the Great Plains area, and is replaced in the Ouachita Mountains of southern Arkansas and adjacent Oklahoma by the related *P. morsei.*

The original material of this species constituted the basis for the generic name, and, as shown in the preceding history of the genus, consisted of one male labelled "Dakota" and a female from Dallas, Texas. Both of these individuals are now before us. The male specimen in all probability came from the present state of South Dakota, as until November 2, 1889, when statehood was conferred, North and South Dakota were united as "Dakota Territory," which had been the official title of the area from March 2, 1861. Although no other South Dakota material of the species

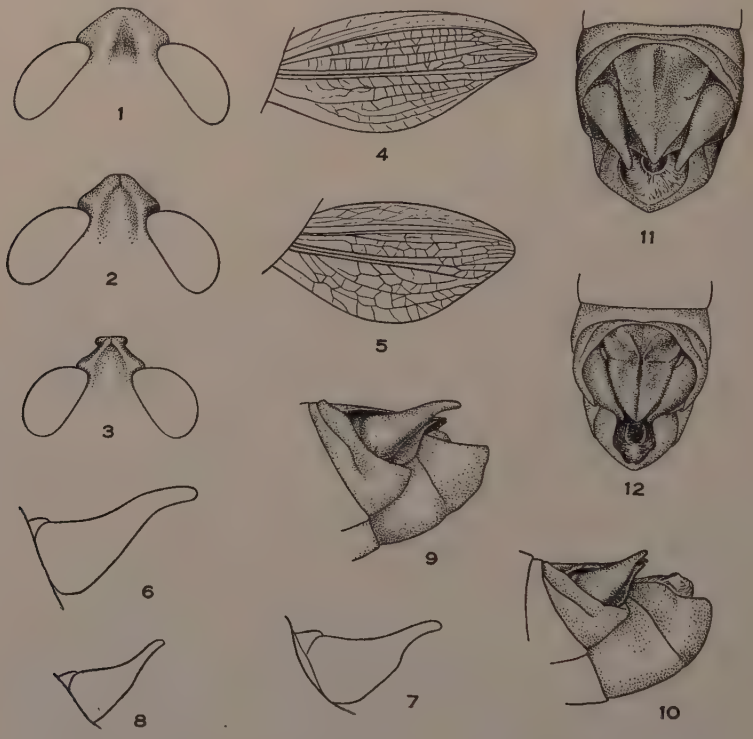
[14] Proc. Acad. Nat. Sci. Phila., 1912, p. 78, (1912).

is known to us, we have examined Iowa material, here recorded, taken in northwest Iowa immediately southeast of the southeastern corner of South Dakota.

Structural variation.—The series of *brunneri* now before us exhibits a very marked amount of variation in a number of structural features, of which the proportionate width and bullation of the pronotum and macropterism have been touched upon in the generic treatment. The extremes in the degree of bullation exhibited in the largest single series of the species which we have examined, i.e. that from Iowa County, Iowa, we have figured, and these illustrations (see plate V, figs. 25 and 27) show more conclusively than any description the range in this respect. Bullation in the male sex is less pronounced than in the female. In the latter the passage from the most extreme type of bullation observed, to a condition showing virtually no bullation, both of which we here figure, is regular and gradual, so much so that no useful purpose is served in trying to grade these individuals for degrees or percentages of emphasis.

The ratio of length to breadth of the pronotal disk shows a very decided range in the same Iowa County series. This, like the bullation, is more evident in the female than in the male sex, but it is, however, quite apparent in the latter. The extremes of these proportion ratios in both sexes in the Iowa County series are here figured (see plate IV, figs. 20–21 (♂), pl. V, figs. 25–26 (♀)).

The exact angle of the converging latero-cephalic borders of the fastigium as seen from the dorsum passes through a very appreciable range of variation in the Iowa County series, this extending from 125 to 135° in the male sex, when measured with a goniometer, as seen in dorsal aspect, while the female sex shows an even more extensive range of from 110 to 140°. In all cases the immediate angle or the apex of the fastigium is very broadly rounded as seen in the same view. Similarly in profile the fastigio-facial angle is seen to vary appreciably in the evenness of its rounding, occasional individuals having it slightly inflated dorsad, this being particularly evident in the female here figured as showing the maximum of pronotal bullation.

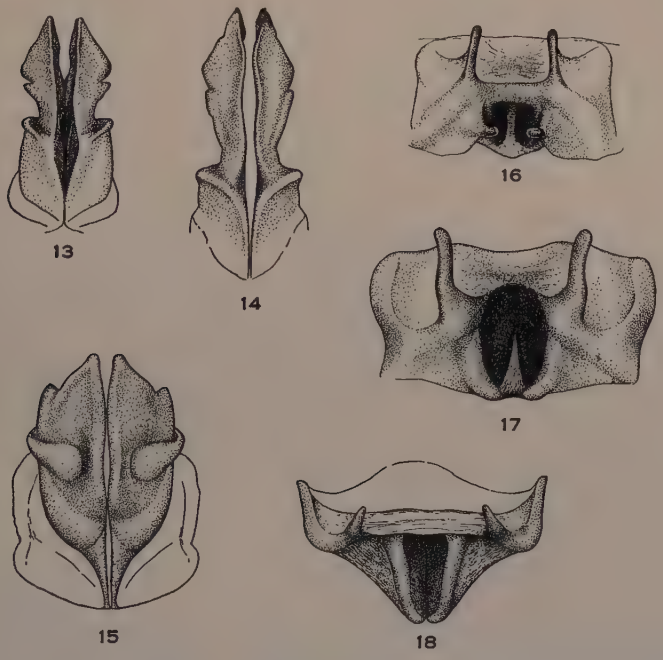


Paratylotropidia brunneri Scudder. Male. Iowa County, Iowa. Fig. 1.—Dorsal view of fastigium (greatly enlarged). Fig. 4.—Lateral view of tegmen (× 4). Fig. 6.—Outline of cercus (greatly enlarged). Male. Iowa County, Iowa. Fig. 9.—Lateral view of apex of abdomen (greatly enlarged). Fig. 11.—Dorsal view of apex of abdomen (greatly enlarged).

Paratylotropidia morsei new species. Male (*type*). Magazine Mountain, Arkansas. Fig. 2.—Dorsal view of fastigium (greatly enlarged). Fig. 5.—Lateral view of tegmen (× 4). Fig. 7.—Outline of cercus (greatly enlarged).

Paratylotropidia beutenmuelleri Morse. Male. Hendersonville, North Carolina. Fig. 3.—Dorsal view of fastigium (greatly enlarged). Fig. 8.—Outline of cercus (greatly enlarged). Male. Rocky Bottom, South Carolina. Fig. 10.—Lateral view of apex of abdomen (greatly enlarged). Fig. 12.—Dorsal view of apex of abdomen (greatly enlarged).

The tegmina in the usual reduced tegmined condition in the male sex range from as short as subequal to the median length of the pronotal dorsum to an opposite extreme in which the tegminal length is equal to one and one-half times that of the pronotal dorsum. In the female sex the same range is from subequal to the median pronotal length to one and one-third times the same dimension. The five macropterous individuals seen by



Paratylotropidia brunneri Scudder. Male. Iowa County, Iowa. Fig. 13.—Caudal aspect of exserted aedeagus (greatly enlarged). Fig. 16.—Dorsal aspect of epiphallus (greatly enlarged).

Paratylotropidia morsei new species. Male (*type*). Magazine Mountain, Arkansas. Fig. 14.—Caudal aspect of exserted aedeagus (greatly enlarged). Fig. 17.—Dorsal aspect of epiphallus (greatly enlarged).

Paratylotropidia beutenmuelleri Morse. Male. Hendersonville, North Carolina. Fig. 15.—Caudal aspect of exserted aedeagus (greatly enlarged). Fig. 18.—Dorsal aspect of epiphallus (greatly enlarged).

us are females,[15] and in these the tegmina and wings reach to or even surpass the apices of the caudal femora. King's notes[16] show that macropterism in *brunneri* can be much more numerous in percentage than the material before us would indicate. Of eighty females taken by him at Oakland Mills State Park, Henry Co., Iowa, thirteen were macropterous, of six of the same sex taken at Lacey-Keosauqua State Park, Van Buren Co., Iowa, one was macropterous, and of eight females from Lake Wapello State Park, Davis Co., Iowa, two were macropterous. No macropterous male has been reported and none is known to us.

Measurements (in millimeters) of extremes or representative individuals

	Length of body	Length of pronotum	Length of tegmen	Length of caudal femur
♂, "Dakota," *type*	25.3[17]	8	8.5	16
♂, Iowa Co., Iowa	25[17]	7	7.6	15
♂, Iowa Co., Iowa	30.5	7.3	10	16
♂, Pawnee, Oklahoma	34.5[18]	8	8.5	16.8
♂, Sulphur, Oklahoma	31.5[18]	8	7.8	16
♀, Iowa Co., Iowa	32.8	8.5	8.5	16.5
♀, Iowa Co., Iowa	40.5	10	10	19
♀, Van Buren Co., Iowa (macropterous)	34.6	9.2	24	18.2
♀, Augusta, Illinois	32	8.5	8.3	17
♀, Columbia, Missouri	35.5	9	10	17.5
♀, Mountain Grove, Missouri	38.2	10	11	19
♀, Cowley Co., Kansas	36.5	10	11	18.5
♀, Sulphur, Oklahoma	37	9.5	10	18
♀, Caddo, Oklahoma	38	10.2	10	19
♀, Dallas, Texas, *allotype*	40.5	10	11	19

It is evident from the above measurements that the range of individual size variation is considerable in both sexes, but as a whole is more marked in the female. Apparently, however, there is little areal correlation of the measurements, and it would seem that as a whole virtually no geographic size variation is indicated.

[15] Van Buren Co., Iowa; IX, 1, 1937; (L. A. Spain); 1♀; [A.N.S.P.]: Iowa Co., Iowa; VII, 18 and 25, VIII, 1, 1937; (R. L. King); 4♀; [A.N.S.P. and Hebard Cln.].

[16] Proc. Iowa Acad. Sci., XLVI, p. 418, (1940).

[17] Apex of abdomen strongly recurved. Measurement given is straight line distance to most caudal point of abdomen, not necessarily apex of subgenital plate.

[18] Apex of abdomen is distended and length in consequence excessive, due to relaxation and extrusion of internal genitalia.

The length of the normal type of tegmina varies very appreciably as compared with the pronotal length, as has already been discussed.

Coloration.—As a whole the coloration of this species varies chiefly in a range of general tonal depth, the male type, as described by Scudder, representing a pale extreme, while the dark extreme tends toward seal brown or bone brown (of Ridgway) in the base color. In its most marked condition the latter is relatively scarce, but nine specimens of the ninety-eight examined representing or even closely approximating this extreme. The greater portion of the representation, and what may fairly be called the mean, has the darker base color cinnamon-brown.

In nearly all the specimens seen the pale lateral postocular bars on the head, lateral angles of the pronotum and the vicinity of the anal vein of the tegmina, as well as the oblique bars on the pleura, are quite marked, and in those in which they are not pronounced this less evident condition may be due to desiccation changes, as in all they are evident on at least a part of the tegmina. The paired series of pale spots on the abdominal dorsum are marked, or at least well evident, in most of the males seen, occasionally, however, subobsolete, yet the surface structure difference, which accompanies these markings, is evident, and this probably indicates the deterioration of the pigment during desiccation. The emphasis of these paired pale areas is less pronounced in the female than in the male, yet in the single macropterous female seen the structural base of these markings is definitely evident.

The caudal femora in both sexes exhibit an appreciable tonal range in the color of the dorso-external face, which is usually quite pale and buffy, but may darken sufficiently to show little or no contrast. The external pagina of the caudal femora also vary quite markedly in the breadth of their infuscation, which in one extreme may merely outline the "herring-bone" pattern, and in the other so completely mantle the whole surface that the paginal pattern is evident only by its structural relief. The color of the caudal tibiae may range from as light as scarlet-red (of Ridgway) to as dark as maroon, this latter paling to dragon's-blood red on the flexor surface.

Distribution.—The known range of *P. brunneri* (see map) extends from probably South Dakota [19] southward to northeastern Texas (Dallas), eastward across Iowa (in which state it is known from the northwest corner and the southeastern portion), extreme western Illinois (Augusta), southern and south-central Missouri (Columbia and Mountain Grove) to northeastern Arkansas (Corning), while westward it is known to reach as far as east-central Kansas (Cowley County) and central Oklahoma (Pawnee, Caddo and Sulphur). No definite records are known from Nebraska, but the species doubtless occurs in suitable areas over at least the eastern fourth of the state. Within the area of its distribution *brunneri* is extremely local and in consequence its occurrence is spotty, localities with the species present in relative abundance being separated from one another by extensive stretches of country where it probably does not occur.

We do not believe *brunneri* extends west of the prairie areas, and feel that it is completely absent from the Great Plains. As far as we know it does not occur in the Ouachita Mountains of Arkansas and southeastern Oklahoma, where it is replaced by the here-described *P. morsei,* but we would not be surprised if the future should show the distributional area of *brunneri* largely encircles that of *P. morsei.* It is quite possible the northern boundary of the distribution of *brunneri* will be found to coincide approximately with the border of the Wisconsin glaciation.

King has sent us immature individuals of this species taken by him on May 13 in Iowa County, and also reported them as occurring as late as July 18 in Henry Co., Iowa. Adults reported by him were taken as early as July 4 (Oakland Mills State Park, Iowa) and as late as September 16 (same locality). Before us we have a teneral adult taken as early as June 6 (Corning, Arkansas) and fully hardened material on June 8 (Oakland Mills State Park, Iowa), while it is also represented as late as September 16 (Iowa County, Iowa). Late material is duller in

[19] The sole background for this is the "Dakota" label on the type. While no exact records are known of the species' occurrence in South Dakota, it is here recorded from Sargent's Bluff, Iowa, on the east bank of the Missouri River and virtually within sight of the southeastern corner of South Dakota. The territory of "Dakota" was not officially divided into two parts until 1889, when the states of North Dakota and South Dakota were formed and admitted to the Union. The type was doubtless collected prior to 1889.

color and somewhat less contrasted than individuals taken earlier in the season.

Habits.—The information available on the habits of *P. brunneri* is exceedingly limited. At Mt. Pleasant, Iowa, Knutson took it in open woods and on tall ironweed in open woods, and at Corning, Arkansas on blue grass of open woods. This covers the information carried by the material now before us. The past literature is virtually barren of similar notes except that Knutson and Jaques reported it as taken on the Burlington Golf Grounds in Des Moines County, Iowa, Knutson states that in Henry County, Iowa, it was taken in "a sloping shaded area covered with short unmowed grass and dead leaves," while Blair and Hubbell considered it to be a form of the Osage Savanna district of Oklahoma, which is an area of scrubby forest and grassland. It is probable that while the genus is not definitely a forest one, the preference of this species is for weedy or grassy areas contiguous to woodland.

Dr. King (in litt.) has kindly supplied us with the following summary of the habits of *P. brunneri,* drawn from his experience with the species. *"Paratylotropidia* [*brunneri*] is found in open tracts in woods, along paths and in thickets along the margins of woods. One macropterous female was found nearly a quarter of a mile from the woods, along a dusty road, in Henry County, Iowa (Lake Wapello State Park). The species is usually rare in the adult condition, but nymphs are rather common. This may be due to the fact that the adults become very scarce before the main collecting season. In 1937 the species was locally very plentiful. The females are clumsy and easily picked up by hand; the males are much more agile and relatively difficult to capture. We have taken many more females than males, both as nymphs and as adults."

Material examined: 104; 31 ♂, 63 ♀, 3 immature ♂, 7 immature ♀.

"Dakota" (probably South Dakota): 1 ♂ (*type*); [Hebard Cln. ex Bruner].

Iowa: Sargent's Bluff, Woodbury County; IX, 6, 1914; (M. P. Somes); 1 ♀; [Hebard Cln.]. Iowa County; V, 13 (juv.), VII, 16, 18, 25 & 31, VIII, 1, IX, 16, 1937; (R. L. King); 24 ♂, 35 ♀, 3 immat. ♂, 3 immat. ♀; [A.N.S.P. and Hebard Cln.]. Mount Pleasant, Henry County; VI, 23 & 28, 1940; ("died in rearing cage"; Herbert Knutson); 1 ♂, 6 ♀: VI, 13

(2 very small immature individuals), VI, 23, 24 & 28, VII, 8, 1940; ("open woods" and "tall ironweed in open woods"; Herbert Knutson); 2 ♂, 9 ♀, 4 immat. ♀; [A.N.S.P. and Knutson Cln.]. Oakland Mills State Park, Henry County; VII, 3 & 8, 1940; ("open woods"; Alta and Frank Knutson); 1 ♂, 1 ♀; [Knutson Cln.]. Van Buren County; (L. A. Spain); IX, 1, 1937; 2 ♀ (1 macropterous); [A.N.S.P.].

ILLINOIS: Augusta; IX, 12, 1939; (C. Weinman); 1 ♀; [Hebard Cln.].

KANSAS: Cowley County, elevation 1114 feet; 1916; 1 ♀; [Hebard Cln.].

MISSOURI: Columbia; 1 ♀; [M.C.Z.]: 1903; (C. R. Crosby); 1 ♀; [M.C.Z.]: VII, 31, 1905; 1 ♀; [Hebard Cln.]. Mountain Grove; VI, 14, 1915; (M. P. Somes); 1 ♀; [U.S.N.M.].

ARKANSAS: Corning, Clay County; VI, 6, 1940; ("in 'blue grass' of open woods"; Herbert Knutson); 1 ♀ (teneral); [Knutson Cln.].

OKLAHOMA: Pawnee; VII, 20, 1932; 1 ♂; [Hebard Cln.]. Sulphur; VII, 14, 1937; (Standish and Kaiser); 1 ♂, 1 ♀; [Hebard Cln.]. Caddo; VIII, 9, 1905; (A. P. Morse); 1 ♀; [Hebard Cln.].

TEXAS: Dallas; (Boll); 1 ♀ (*allotype*); [U.S.N.M.].

Paratylotropidia morsei[20] new species (Text-figs. 2, 5, 7, 14 and 17.)

1907. *Paratylotropidia brunneri* Morse, Carneg. Inst. Wash. Publ. no. 68, p. 46. (In part.) [Magazine Mountain and Mena, Arkansas.]

1938. *Paratylotropidia brunneri* Blair and Hubbell, Amer. Midland Naturalist, xx, p. 446. (In part.) [Ouachita district of Oklahoma.]

This is a very distinctive species, as far as known at present limited in its distribution to the Ouachita Mountain area of south-central Arkansas and southeastern Oklahoma. Its area of distribution is bordered on the north, west and even southwest by that of *P. brunneri,* with which it has been confused for thirty-five years.

When compared with *P. brunneri,* which is its nearest relative, *P. morsei* can at once be distinguished in both sexes by the short, subovoid, instead of lanceolate, tegmina, the distal extremity of which is rounded, and not acute or subfalcate as in *brunneri,* and the definitely narrower fastigium as seen from the dorsum. In the male sex the cercus is seen to be more sharply narrowed distad than in *brunneri,* in which species the cercal distal attenuation is more gradual, and the ancorae of the epiphallus of the concealed genitalia are less widely separated and subparallel, rather than somewhat diverging distad. Also in the female sex the ventro-internal border of the ventral ovipositor valves in *morsei* is more

[20] In memory of the late Albert Pitts Morse, fellow-worker and friend, who in his field investigations of 1905 collected the first material of this species.

elevated than is the usual condition in *brunneri,* showing a low longitudinal ridge the surface of which slopes laterad to the ventro-external margin.

Type.—♂; Summit of Magazine Mountain, Logan County, Arkansas. Elevation, 2800 feet. August 13, 1939. (Rehn and Rehn; in low grass and weeds.) [Academy of Natural Sciences of Philadelphia, Type no. 5685.]

General size, form and surface sculpture very similar to that of the same sex of *P. brunneri.*

Head as seen in profile with occipital line much more flattened and less arcuate than in *P. brunneri,* less strongly declivent ventro-cephalad toward fastigio-facial angle, which in the same view is more marked and less rounded than in *brunneri,* as seen from the dorsum the fastigium as a whole is narrower, with the angle of the converging cephalic outlines less broadly obtuse, while the interocular space dorsad is similarly narrowed, being contained approximately 3.6 times in the width of the head across the genae, as against 3.2 in *P. brunneri;* disk of fastigium with impressed area more sharply defined than in *brunneri,* acute semi-elliptical in outline, bordering margins laterad markedly and evenly converging cephalad to the subacute apex of the depression, which caudad terminates between the eyes; area of the lateral foveolae more subvertical than in *brunneri,* cribroso-punctate as in that species; frontal costa slightly narrower than in *brunneri,* particularly dorsad where its reduced width corresponds with that of the dorsal interocular space; facial line in profile as in *brunneri:* eyes slightly more prominent than in *brunneri* when seen from the dorsum, in lateral view of similar outline. Antennae slightly surpassing the combined length of the head and pronotum.

Pronotum essentially as in *brunneri,* the caudal margin of the disk slightly nearer transverse truncate.

Tegmina slightly shorter than the dorsal length of the pronotal disk, sub-ovoid in outline, their greatest width equal to but two-thirds of their length, distal portion narrowly rounded, not at all falcate or definitely acute as in *brunneri;* costal margin strongly arcuate mesad, straighter and more oblique proximad and distad, sutural margin evenly and broadly arcuate throughout; anal area of tegmina with its greatest width subequal to half that of the combined marginal and discoidal fields; venation as a whole similar to that of *brunneri,* but mediastine vein less clearly marked and more confused with the general anastomosing. Wings greatly reduced, rudimentary, shorter than and completely covered by the tegmina.

Prosternum as in *brunneri* with process conical and but slightly inclined caudad. Interspace between mesosternal lobes moderately longitudinal, its width but slightly more than one-third the breadth of one of the lobes. Metasternal lobes but narrowly separated caudad of the foramina.

Apex of abdomen lacking furcula; supra-anal plate essentially as in *brunneri* in shape, proportions and sculpture; cerci of the general type seen in *brunneri,* but the plate-like proximal section is deeper both actually and proportionately, and the narrowed distal extremity is slightly more attenuate, with the ventral margin of the cercus at the point of passage from the broadened base to the attenuate apex having a slight but noticeable shoulder; subgenital plate essentially as in *P. brunneri:* ancorae [21] of epiphallus of internal genitalia slightly closer to one another than in *brunneri,* their arms slightly diverging distad, surface of the epiphallus between more strongly concave and flexed ventrad than in *brunneri;* aedeagus [21] quite similar to that of *brunneri* except that in caudal aspect the valves of the same are somewhat narrower, more attenuate and appreciably more tapering distad.

Limbs essentially as in *P. brunneri.*

Allotype.—♀; Five miles northeast of Finlay, Pushmataha County, Oklahoma. June 17, 1938. (W. Frank Blair.) [Hebard Collection.]

Differing from the above description of the male sex (type) in the following noteworthy features.

Head in profile, when compared with that of the female sex of *brunneri,* having the difference in the fastigio-facial angle, noted in the description of the male, less pronounced; fastigium less prominent than in *brunneri* as seen from the dorsum, the angle of its converging cephalic margins much as in that species, but the proportionate width of the fastigium to that of the head across the genae is less, being approximately 2.7 times, against 2.25 in the female of *brunneri;* disk of fastigium less sharply defined than in male, more nearly as in *brunneri;* frontal costa slightly narrower than in *brunneri,* particularly dorsad; eyes as in male, very slightly more prominent than in female of *brunneri* when seen from the dorsum. Antennae with length subequal to the combined length of head and pronotum.

Interspace between mesosternal lobes subquadrate, its breadth but slightly more than half that of one of the lobes. Interspace between metasternal lobes somewhat narrower than that between mesosternal lobes.

Supra-anal plate acute trigonal, but slightly broader proximad than in the female of *brunneri,* subarcuate in transverse section, its surface lightly sculptured by a shallow and broken medio-longitudinal impression; cerci shorter, stouter proximad and with their ventral margin more convex than the dorsal, instead of with the two more evenly converging distad as in *brunneri;* ovipositor valves as in *brunneri* with the apices of each valve similarly bifid, except that the ventral surface of the ventral valves have their internal margins more lamellately elevated and in profile more arcuate than in *brunneri;* subgenital plate with median triangular production of the distal margin broader at base than in *brunneri.*

[21] See Roberts (Proc. Acad. Nat. Sci. Phila., XCIII, p. 241, (1941)) for the use of this term.

Measurements (in millimeters)

	Length of body	Length of pronotum	Length of tegmen	Length of caudal femur
♂, Magazine Mtn., Arkansas, *type*	31.8[22]	8	7	15.2
♂, Magazine Mtn., Arkansas, *paratype*	26[23]	7.8	6.6	15.3
♂, Magazine Mtn., Arkansas, *paratype*	26.2[23]	7.6	5.9	15
♂, 5 m. N.E. of Finlay, Pushmataha Co., Oklahoma, *paratype*	36[22]	8.5	8.4	16
♀, Magazine Mtn., Arkansas, *paratype*	33.5[24]	9.3	6.8	17.3
♀, Mena, Arkansas, *paratype*	34	9	7.5	18
♀, 5 m. N.E. of Finlay, Pushmataha Co., Oklahoma, *allotype*	36[24]	10	8	19.2

Coloration.—The color pattern and general tones in *P. morsei* are essentially as in *brunneri.* In the available series of the former, however, the pale lateral lines on the lateral angles of the pronotal disk, the bars on the pleura and the vicinity of the tegminal anal vein average duller and less decided in contrast. General dark base color ranging from snuff brown to bister and warm sepia, the face paling to as light as clay color, the pale markings on the head, the dorsal faces of the caudal femora and those on the pronotum, pleura and tegmina already mentioned ranging from as pale as cinnamon-buff to as dull as tawny-olive. The abdomen may be as light as cinnamon or sayal brown, or as dark as snuff brown. The external paginae of the caudal femora may or may not be appreciably infuscated. The caudal tibiae are somewhat infuscate briefly proximad and more distad range from as pale as coral red to as dark as indian lake (Ridgway).

Morphological variation.—From the evidence of the very limited series of this species which is available we can say that the fluctuations seen in structural features are essentially the same as those noted for *P. brunneri.* The broad to narrow type of pronotal disk, the degree of arcuation or straight obliqueness of the lateral carinae of the same, and the exact length and relative proportions of the tegmina vary to about the same degree as in *brunneri.* The fluctuation in the degree of bullation of the pronotal dorsum is as clearly marked and probably as broad in its range as in that species.

[22] Length abnormally extended by relaxation of apex of abdomen for extrusion of internal genitalia.

[23] Apex of abdomen markedly recurved. The length of body given is the straight line distance to extreme caudal point of abdomen, not to disto-dorsal border of rim of subgenital plate.

[24] Apex of abdomen somewhat upcurved.

Paratypic series.—We are considering all the specimens seen of this species, in addition to the type and allotype, as paratypes.

Distribution.—As far as at present known this most distinctive species is limited in distribution to the Ouachita Mountains of the Ozark uplift of west-central Arkansas (Mena and Magazine Mountain) and southeastern Oklahoma (5 miles northeast of Finlay). Its altitudinal range within this area reaches from approximately 1000 feet (5 miles northeast of Finlay, Oklahoma) to as high as 2800 (summit of Magazine Mountain, Arkansas). On the west its range is bounded by that of *P. brunneri,* but whether *morsei* is limited to the Ouachita group of the Ozarks, or occurs in the Boston Mountains north of the Arkansas River as well, remains to be determined.

All available data on the occurrence of *P. morsei* shows that it occurs adult at least as early as June 17 (5 miles northeast of Finlay, Oklahoma) and as late as August 29 (Magazine Mountain, Arkansas).

Habits.—Morse captured this species "among the shrubby undergrowth of dry, stony woodlands" at Mena, Arkansas, and in thickets near the summit of Magazine Mountain in the same state. On the latter we found the single specimen taken in very low short grass and weeds in open prairie conditions, surrounded by woods of oak and hickory on the summit plateau. Although extensive search was made of the entire prairie area and the borders of the margining woodland, no other individuals were seen. Morse considered it as "rare," so apparently he encountered but few specimens in his field work. Probably like *brunneri* the species may be locally numerous under certain conditions, but we have no definite information on this point.

Specimens examined: 7; 4♂, 3♀.

ARKANSAS: Magazine Mountain, Logan Co., summit, elevation 2800 feet; VIII, 13, 1939; (Rehn and Rehn); 1♂ (*type*); [A.N.S.P.]: elevation 2600 feet; VIII, 29, 1905; (A. P. Morse); 2♂, 1♀ (*paratypes*); [M.C.Z. and Hebard Cln.]. Mena, Polk Co.; VII, 30, 1905; (A. P. Morse); 1♀ (*paratype*); [M.C.Z.].

OKLAHOMA: Five miles northeast of Finlay, Pushmataha Co.; VI, 17, 1938; (W. Frank Blair); 1♂ (*paratype*), 1♀ (*allotype*); [Hebard Cln.].

Paratylotropidia beutenmuelleri Morse (Text-figs. 3, 8, 10, 12, 15 and 18, pl. V, figs. 28–30.)

1907. *Paratylotropidia beutenmuelleri* Morse, Psyche, XIV, p. 14. [♀; Valley of Black Mountain, North Carolina.]

1920. *Paratylotropidia beutenmuelleri* Blatchley, Orth. N. E. Amer., p. 349. [♀; near Black Mountain, North Carolina.]

1932. *Paratylotropidia beutenmuelleri* Sherman, Proc. Entom. Soc. Wash., XXXIV, p. 85. [Pinnacle Mountain, Pickens Co., South Carolina; Clemson College, South Carolina; North Carolina side of North–South Carolina boundary three miles north of Rocky Bottom, Pickens Co., South Carolina.]

1932. *Paratylotropidia beutenmuelleri* Caudell, Proc. Entom. Soc. Wash., XXXIV, p. 86, text-fig. [♂ (described); North Carolina side of North–South Carolina boundary three miles north of Rocky Bottom, Pickens Co., South Carolina.]

1938. *P*[*aratylotropidia*] *beutenmulleri* Brimley, Insects of No. Carolina, p. 26. [Black Mountain, North Carolina; Flat Rock near Henderson, North Carolina; Transylvania County, North Carolina.]

This eastern or Appalachian member of the genus shows a very considerable degree of plasticity in numerous structural features. In selected individuals these appear so distinct that without the evidence of series taken at the same place and under the same conditions, one could readily infer two or more forms were represented.

The original description of the female sex and the subsequently published one by Caudell of the male, supply the leading features characterizing this very interesting species. The more outstanding and sharply diagnostic characters, when compared with those of other members of the genus, are here used in the key to distinguish the species.

Structural variation.—The exact outline of the fastigium, and the correlated shape of the impressed disk of the same, varies appreciably in individuals of the male sex, and to a lesser degree in the female. The angle of the converging cephalic margins of the fastigium in the males of the Sassafras Mountain series alone ranges from rectangulate to quite definitely obtuse-angulate. The pronotum shows a distinct but not pronounced degree of individual variation in the rounding of the median point of the very obtuse-angulate caudal margin of the disk, while the surface of the prozonal portion of the latter shows a similar range in the extent to

which it is impresso-punctate. In some individuals this latter condition suggests, but more weakly, the subcribrose puncta of the metazonal portion of the discal surface, while in others the prozonal disk is virtually impunctate. The short and very broad tegmina vary but slightly in their exact outline, while the caudal femora show an appreciable range of variation in relative depth to length in the extremes from the same locality. The form of the male supra-anal plate and of the male cerci remain relatively uniform in the material before us, but the ancorae of the epiphallus of the internal male genitalia exhibit some variation in their relative length and slenderness.

Measurements (in millimeters) of representative or extreme individuals

	Length of body	Length of pronotum	Length of tegmen	Length of caudal femur
♂, Near Gore, Virginia	21.5	6.1	4.4	12
♂, Skyline Drive, Blue Ridge, Virginia	21.2	6	4	12
♂, Hendersonville, North Carolina.	24	6.5	4.4	12.8
♂, Rocky Bottom, South Carolina..	20 [25]	6.8	4.4	13.1
♂, Sassafras Mountain, South Carolina	22.8 [25]	6.8	5.2	13.6
♂, CCC Camp F2, Oconee Co., South Carolina	20 [25]	6.3	3.7	12.5
♂, CCC Camp F2, Oconee Co., South Carolina	23.5	6.8	4.6	12.2
♀, Near Gore, Virginia	30.8	8.6	4.7	14.5
♀, Black Mountain, North Carolina	28	7.9	5	14.8
♀, Hendersonville, North Carolina.	25 [26]	7.5	4	13
♀, Flat Rock, near Hendersonville, North Carolina	29.5	9	5	15
♀, Rocky Bottom, South Carolina..	25 [26]	8.3	5.2	14
♀, Rocky Bottom, South Carolina..	31	8.6	6.2	16
♀, CCC Camp F2, Oconee Co., South Carolina	28	8.8	4.9	15
♀, CCC Camp F2, Oconee Co., South Carolina	35.5	9.3	5	16
♀, Clemson College, South Carolina	32.7	9	6.2	16
♀, Saluda, South Carolina	31	9.4	6.5	15.7

[25] Apex of abdomen moderately recurved dorsad.

[26] Abdomen considerably retracted.

While it would appear from these figures that the average size of individuals in the more southern representations is slightly greater than is true of the much more limited series from localities to the northward, I feel this is due to the broader size range naturally found in the more extensive representations from South Carolina. Larger series from Virginia areas from which the species is known conceivably could show an equally broad range of size.

Color variation.—A tendency toward more rufescence on one hand and more gray-brown on the other covers the range noted in coloration from the normal neutral wood brown tone. The dorso-external face of the caudal femora is more definitely and contrastingly ochraceous in some individuals than in others.

Distribution.—The range of *P. beutenmuelleri* is from Frederick County (two miles west of Gore), on the eastern front of the Alleghanies, and the Blue Ridge of Shenandoah National Park (Skyline Drive), northern Virginia, southward to the vicinity of Black Mountain, Hendersonville and Transylvania County, North Carolina, the Saluda Mountain area of South Carolina (Pickens and Oconee Counties) and as far into the Piedmont of the latter state as Saluda, Saluda County. We have no information on the occurrence of the species in West Virginia or in the mountains of southern Virginia, although it most certainly occurs in both of these areas, the Gore locality particularly being but a few miles from the West Virginia line. Similarly we have no knowledge of the occurrence of the genus in the Big Smoky Mountains and similar groups on the North Carolina-Tennessee line, in the Cumberland Mountains on the Kentucky border, or in the northeastern corner of Georgia, although we feel certain future field work will bring it to light in these sections. Its occurrence at Saluda, South Carolina, shows definitely it is an intrusive type in the Piedmont, and it probably is also present in this less elevated physiographic area in North Carolina.

Present information shows that *beutenmuelleri* occurs in South Carolina from as low as 400 feet at Saluda, to as high as 3500 on Sassafras Mountain. In Virginia it was taken at Gore as low as 940 feet, and on the Skyline Drive on the Blue Ridge as high as 3200 feet.

In the series before us the earliest date represented by adult material is May 31, when both adults and immature individuals were taken at Rocky Bottom, South Carolina. One day earlier (May 30) is represented by another immature individual, this from Clemson College, South Carolina, while material similarly immature, taken with adults, represents a period as late as July 1 to 15 (Mountain Rest, South Carolina). The latest date represented by freshly captured adult material is October 31 (Saluda, South Carolina), although one specimen, not badly altered, was found in the stomach of a wild turkey shot November 20 (Jenning's Creek, Virginia). It is evident that the period during which this insect is adult reaches from the end of May certainly to mid-November.

Habits.—From the information now available *P. beutenmuelleri* frequents types of environment which would hardly be considered the choice of a very local and, broadly speaking, relatively rare insect. While on Pinnacle Mountain, South Carolina, Sherman reported it as occurring in "sparse grassy woods," and at Saluda, South Carolina, as found "in an open grassy glade in mixed woods," in the Sassafras Mountain and Rocky Bottom district he reported taking "six within a space of about an acre in an abandoned orchard pasture, now in grass, weeds and bushes." Fox (in litt.) says regarding the species in several habitats at Hendersonville and Flat Rock, North Carolina: "Mostly found in an old strawberry patch overgrown with briars and weeds—a most unlikely spot to look for rare Orthoptera," and again, "I found it very sluggish, and when first seen indistinctly in the grass I mistook it for an *Atlanticus,* to which it seemed to bear considerable superficial resemblance both in appearance and to some extent in habits." Continuing he added, "I was surprised to find it in all but one instance in quite ordinary surroundings . . . an old field on the side of a shallow ravine . . . nothing more than a mass of common weeds and briars, with numerous strawberry vines and occasional clumps of a dry grass—probably *Andropogon.* Most *Paratylotropidia* were taken in this grass, where they were apparently hiding. One example was taken in a clump of grass in blueberry scrub of clearing along edge of woods." Near Gore, Virginia, we found it in a grown-up "burn" of mixed deciduous

brush (oak, locust, etc.), with huckleberry as low ground cover, although the ground was completely bare in places. The two specimens from there—all seen although extensive search was made for more—were taken singly, the female on low oak, the male on huckleberry.

From the comments of Sherman and Fox the species, or at least the female sex, is quite sluggish, jumping clumsily and easily captured when once seen.

Specimens examined: 111; 45 ♂, 58 ♀, 2 immature ♂, 6 immature ♀.

VIRGINIA: Two miles west of Gore, Frederick Co., elevation 940 feet; VIII, 8, 1936; (Rehn and Rehn); 1 ♂, 1 ♀; [A.N.S.P.]. Skyline Drive, 15 miles south of Panorama, Shenandoah National Park, elevation 3200 feet; VIII, 13, 1933; (H. A. Allard); 1 ♂; [U.S.N.M.]. Jenning's Creek, 12 miles west of Staunton (from wild turkey's stomach); XI, 20, 1935; 1 ♀; [U.S.N.M.].

NORTH CAROLINA: Black Mountain; VIII, 1912; (Beutenmueller); 1 ♀; [Hebard Cln.]. Hendersonville, Henderson Co.; VI, 21, 1924; (H. Fox); 2 ♂, 3 ♀, 1 immat. ♂, 1 immat. ♀; [Hebard Cln.]. Flat Rock, near Hendersonville, Henderson Co.; VI, 23–24, 1924; (H. Fox); 1 ♂, 1 ♀; [Hebard Cln.]. Transylvania County side of Saluda Mountains, about three miles north of Rocky Bottom, South Carolina; VIII, 25, 1932; 1 ♀; [North Carolina Dept. of Agr.].[27]

SOUTH CAROLINA: Pinnacle Mountain, Pickens Co.; VIII, 3, 1926; (F. Sherman); 1 ♀; [U.S.N.M.][28] Sassafras Mountain, north of Rocky Bottom, Pickens Co., elevation given on majority as 3500 feet; VI, 26, 1934, VII, 31, 1934, VIII, 25, 1932, IX, 4, 1934; IX, 16, 1938, X, 6, 1933; (collected chiefly by F. Sherman, a few by O. L. Cartwright and D. Dunavan); 20 ♂, 21 ♀; [Clemson College, A.N.S.P., Hebard Cln. and M.C.Z.]. Rocky Bottom, Pickens Co., elevation 2700 feet; V, 31, 1933 (adult and immature), VI, 1, 1933 (immat.), VI, 20, 1933 (immat.), VI, 21, 1932, VII, 30, 1932, VII, 31, 1934,[29] VIII, 25, 1932, VIII, 31, 1930, X, 12 and 23, 1932; (collected chiefly by F. Sherman, a few by O. L. Cartwright); 9 ♂, 13 ♀, 3 immature ♀; [Clemson College, A.N.S.P., Hebard Cln. and U.S.N.M.]. Cashiers Valley Road, Oconee Co.; X, 3–16, 1934; (F. Sherman and O. L. Cartwright); 1 ♂, 1 ♀; [Hebard Cln.]. CCC Camp F 2, Oconee Co.; VI, 12, 1937 (immat.), VI, 18, 26 and 28, 1936, VII, 29, 1937, VIII, 12, 13 and 21, 1936, IX, 22, 1937; (F. Sherman); 10 ♂, 9 ♀, 1 immature ♀; [Clemson College and A.N.S.P.]. Mountain Rest, Oconee State Park; VI, 12, 1934

[27] This is one of the specimens forming the basis of Brimley's Transylvania County record.

[28] This individual was recorded by Sherman, Proc. Entom. Soc. Wash., XXXIV, p. 85, (1932).

[29] The male bearing this date belonging to the United States National Museum is the allotype of the species described by Caudell (Proc. Entom. Soc. Wash., XXXIV, p. 86, fig., (1932).

(immature), VII, 1–15, 1937; (F. Sherman); 1 ♀, 1 immature ♀; [Clemson College]. Ten miles north of Pickens; VI, 24, 1934; (F. Sherman); 1 ♀; [Clemson College]. Clemson College, Oconee Co.; V, 30, 1939; (F. Sherman); 1 immature ♂; [Clemson College]: X, 2, 1926; (G. E. Hudson); 1 ♀; [U.S.N.M.].[80] Saluda; X, 31, 1930; (F. Sherman); 1 ♀; [U.S.N.M.][81]

Explanation of Plates

Plate IV

Paratylotropidia brunneri Scudder. Male. Iowa County, Iowa. Fig. 19.—Lateral view (× 2). Fig. 20.—Dorsal view (× 2). Male. Iowa County, Iowa. Fig. 21.—Showing narrowest fastigium in males examined (× 2). Male. Iowa County, Iowa. Fig. 22.—Showing broadest fastigium in males examined (× 2). Female. Iowa County, Iowa. Fig. 23.—Lateral view (× 2). Female (macropterous). Van Buren County, Iowa. Fig. 24.—Dorsal view (× 2).

Plate V

Paratylotropidia brunneri Scudder. Female. Iowa County, Iowa. Fig. 25.—Dorsal view of narrower type of pronotum of female (× 2). Female. Iowa County, Iowa. Fig. 26.—Dorsal view of broader type of pronotum of female (× 2). Female. Iowa County, Iowa. Fig. 27.—Dorsal view of inflated type of pronotum of female (× 2).

Paratylotropidia beutenmuelleri Morse. Male. Rocky Bottom, South Carolina. Fig. 28.—Lateral view (× 2). Fig. 29.—Dorsal view (× 2). Female. Two miles west of Gore, Frederick County, Virginia. Fig. 30.—Dorsal view (× 2). Fig. 31.—Lateral view (× 2).

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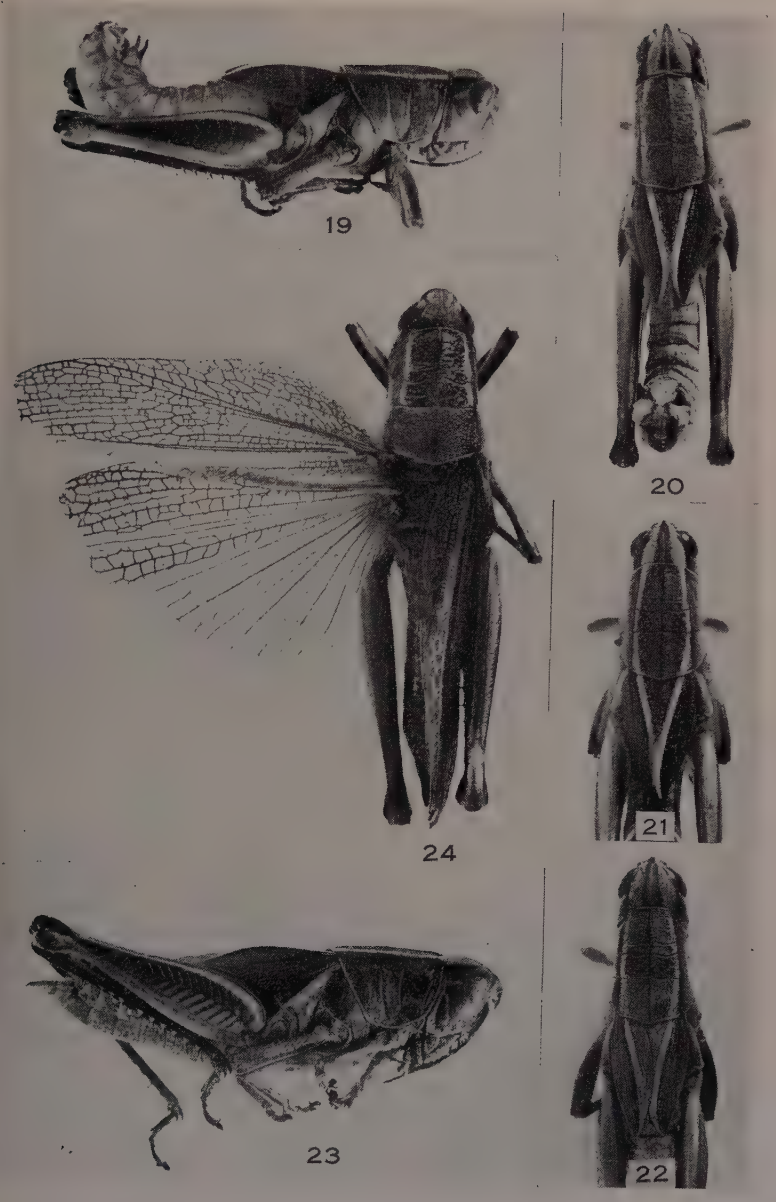
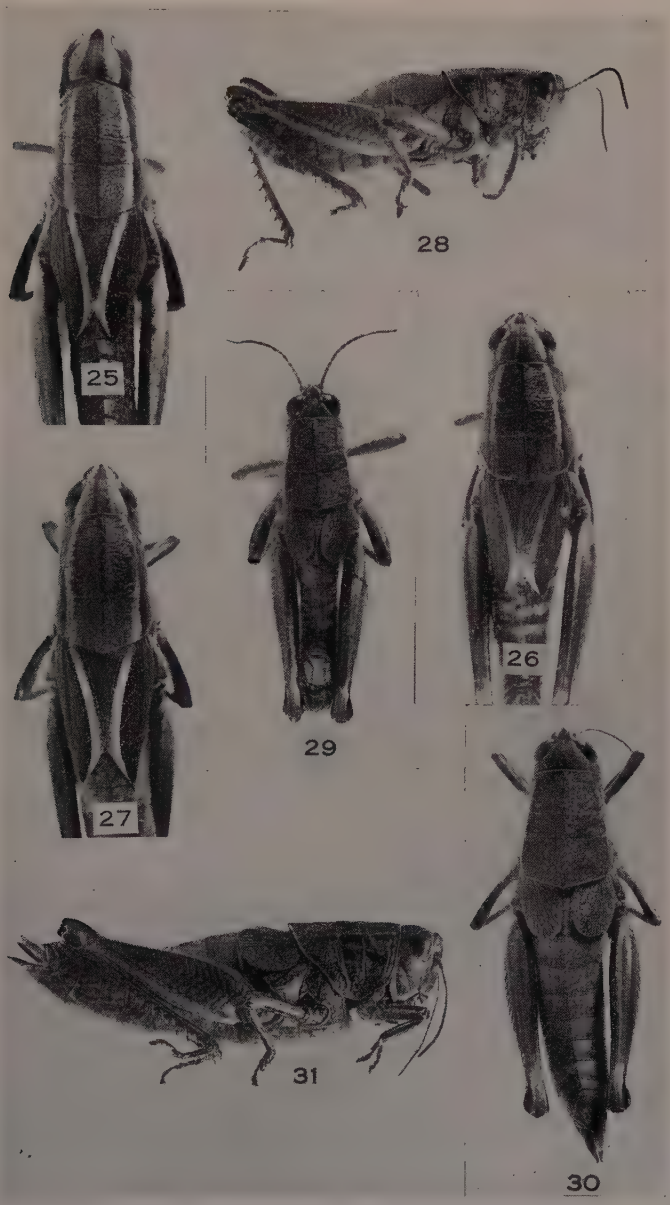
[80] This specimen was reported by Sherman (Proc. Entom. Soc. Wash., XXXIV, p. 85, (1932).

[81] Reported by Sherman (Proc. Entom. Soc. Wash., XXXIV, p. 86, (1932).



REHN AND REHN—PARATYLOTROPIDIA



REHN AND REHN—PARATYLOTROPIDIA

THE NORTH AMERICAN SAWFLIES OF THE GENUS HOPLOCAMPA
(HYMENOPTERA: TENTHREDINIDAE)

BY HERBERT H. ROSS

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(Plates VI to X)

The sawfly genus *Hoplocampa* in North America contains about twenty species all found in the nearctic region with none recorded to date from the neotropical region. In all species of which the biology is known the egg is inserted in the calyx of the flower of one of the Rosaceae, known host genera including *Crataegus, Pyrus, Prunus,* and *Amelanchier.* The larvae tunnel within and hollow out the developing fruit; it is interesting to note that they migrate from one fruit to another before becoming full grown. When full grown they drop to the ground, aestivate and hibernate in the soil and emerge as adults the following spring.

Interest in the genus *Hoplocampa* has been stimulated recently by the introduction of the apple pest, *Hoplocampa testudinea* (Klug), the second economic species of the genus in the American fauna. The other economic species is the native *Hoplocampa cookei* (Clarke) which has been recorded as a pest of domestic cherries in California but appears to be of little significance outside that area.

A study of considerable material soon showed that color characters, on which many species were based, were of diagnostic value in only a few limited instances. Many species show remarkable chromatic phases which can usually be caught together from the same tree. Sometimes different color forms occur together without intergrading forms, in other collections of the same species the extremes and intergrading forms are found together. Rohwer [1] in his revision, introduced several saw characters and this repre-

[1] U.S.D.A., Bur. Ent., Tech. Series, *no. 20,* (*4*), pp. 139–148, (1911).

TRANS. AMER. ENT. SOC., LXIX.

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sented the first major step in the progress of species diagnosis in the genus. Up to the present, however, color, sculpture and small proportional differences in antennae and wing venation, are still used to a large extent in existing keys. Searching further for morphological characters which would be of greater use, I found that the male genitalia furnish admirable diagnostic characters. The saw also furnishes diagnostic characters, but they are usually not so well marked as those of the male genitalia.

It has been necessary to restudy the types in the genus and I am greatly indebted to Dr. E. A. Chapin, U. S. National Museum, Mr. E. T. Cresson Jr., The Academy of Natural Sciences of Philadelphia, and Dr. Nathan Banks of the Museum of Comparative Zoology, for permission to study the types contained in the respective institutions. To Mr. C. F. W. Muesebeck and other staff members of the Division of Insect Identification, U. S. Bureau of Entomology and Plant Quarantine, I am indebted for much valuable assistance. I wish to express appreciation also to the many persons who have collected these specimens at my disposal. I have not been able to study the types of *H. testudinea* (Klug) and *H. flavicornis* (Provancher), but have examined all the others and studied the genital characters.

In the records contained in this paper the institution to whom the material belongs is indicated by abbreviations in square brackets at the end of the record, the key to which is as follows: [ANSP], Academy of Natural Sciences of Philadelphia; [CAS], California Academy of Sciences; [CNM], Canadian National Museum; [CWS], C. W. Sabrosky, Michigan Agricultural College; [EHS], E. H. Strickland, University of Alberta; [GRH], G. R. Hopping, Dominion Entomological Branch, Vernon, B. C.; [HBL], H. B. Leech, Dominion Entomological Branch, Vernon, B. C.; [INHS], Illinois Natural History Survey; [KAS], K. A. Salman, Bureau of Entomology and Plant Quarantine; [UI], MacGillivray Collection, University of Illinois; [NYS], New York State Museum; [OAC], Oregon Agricultural College; [RDB], R. D. Bird, Canadian Entomological Branch, Aweme, Manitoba; [RRD], R. R. Dreisbach, Midland, Michigan; [USNM], U. S. National Museum; [WAC], Washington Agricultural College.

The genus *Hoplocampa* has been one of the most stable generic units in the sawflies. Diagnostic characters and synonymy for the adults have been given by Ross.[2] The larvae are known for insufficient species to formulate a practical key to this stage but useful characters for generic identification have been described by Bird.[3]

Taxonomy

For accurate identifications of adult material it is necessary to clear in caustic soda, or similar solution, the male genitalia or the saw, as the case may be. In the case of the male, I have found it most satisfactory to cut off and clear the apical half of the abdomen. In larger sawflies, such as *Pachynematus,* the genital capsule can be pried out of the abdomen of a relaxed specimen, but this is scarcely practical with *Hoplocampa.* I would recommend preservation in glycerin as outlined by DeLong and Davidson.[4] It is frequently convenient to tease out the penis valves and mount them on a slide, using a glycerin mount for temporary examination or balsam if a permanent slide mount is desired. The capsule itself should not be put on a permanent slide mount since it is necessary to view it from various angles and mobility is required.

The saw can be exerted from the abdomen of a relaxed female by prying it into a position at right angles to the body axis, then cutting it at the extreme base with a pair of fine scissors. After clearing and washing, the saw should be mounted on a permanent slide. It is advisable to tease out the right hand lancet and mount this with the mesal side up. It is convenient to use half cover slips so that both parts of the same saw may be put on one slide. The saw should be pressed out flat on the slide and should be watched and pressed out every two days if necessary until the slide has hardened, in order to prevent curling of the edges of the saw.

In clearing both male genitalia and saws care should be taken to treat them long enough to dissolve the muscle tissue, but not to clear to the point at which the natural sclerotization fades.

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[2] Illinois Biological Monographs, xv, pp. 1–173, (1937).
[3] Ann. Ent. Soc. Amer., xx, pp. 481–486, (1927).
[4] Jour. Ec. Ent., xxi, pp. 372–374, (1937).

Key to Species

1. Apical sternite undivided (Figs. 15–19) (males).....2
   Apical sternite divided by a sheath housing a saw (Fig. 42) (females).....20
2. Apex of penis valves with a long, slender, dorsal process, the pair curved (Fig. 39) or curled and tusk-like (Figs. 40, 41).....3
   Apex of penis valves either without a process or with the process not projecting beyond dorsal edge of valve (Fig. 38).....5
3. Dorsal process of penis valves fairly short, the pair appearing horn-like (Fig. 39).....**montanicola**
   Dorsal process of penis valves long, the two appearing like a pair of curled tusks (Figs. 40, 41).....4
4. Body of penis valve almost rectangular, the apex nearly truncate, the dorsal and ventral margins parallel (Fig. 41).....**cookei**
   Body of penis valve distinctly widened near middle, with the apex narrow and rounded (Fig. 40).....**marlatti**
5. Penis valves with a lateral oblique, sclerotized spur near apical margin, which also is oblique (Fig. 38).....**lacteipennis**
   Penis valves without a lateral spur, at most with a finger-like process which is either apical (Fig. 27) or ventral (Fig. 31).....6
6. Apex of penis valves produced into a very large, ventral, ovoid lobe which is longer than half the length of the valve (Fig. 21). **testudinea**
   Penis valves at most with only a ventral swelling as in figure 30....7
7. Ventral margin of penis valves with a finger-like process (Fig. 31). **stricklandi**
   Ventral margin of penis valves without a slender process.....8
8. Extreme apex of penis valves angled mesad and forming a long projection, and bearing a single, long, slender seta at base of projection (Fig. 20).....**ritcheri**
   Apex of penis valves not angled mesad (Fig. 1).....9
9. Apex of penis valves with a projecting spine entirely surrounded by a thin, membranous glove (Fig. 27).....**oskina**
   Apex of penis valves without a projecting spine.....10
10. Penis valves curved to form a deep bow (Fig. 22).....**oregonensis**
    Penis valves nearly straight, not curved more than figure 26.....11
11. Apical segment of claspers with a swollen area on mesal margin near apex (Fig. 7); penis valves with apex of dorsal membrane produced into a hatchet-like lobe (Fig. 28).....**neneti**
    Apical segment of claspers tapering evenly to apex (Fig. 1); penis valves without an apical projection of the dorsal membrane....12
12. Sagittae broad, the apex forming a wide, sinuate and almost flat margin (Fig. 5).....**bioculata**
    Sagittae narrow (Fig. 4), or pointed at apex (Fig. 2).....13
13. Apical portion of penis valves wide (Fig. 23, 24, 29, 30).....14
    Apical portion of penis valves no wider than figures 26, 32–34)....17

14. Extreme apex of penis valves produced conspicuously into a globular lobe (Fig. 30) ..... **alpestris**
Extreme apex of penis valves only slightly extended (Fig. 29) 15
15. Apico-ventral expanse of penis valves large and flat and entirely covered with sensory pores (Fig. 29) ..... **halcyon**
Apico-ventral expanse of penis valves with a flat mesal area devoid of sensory pores, and a central raised area bearing sensory pores (Figs. 23, 24) 16
16. Apical sternite truncate (Fig. 18); penis valves (Fig. 23) with lateral raised portion narrower, and the apex of the ventro-mesal lobe elongate ..... **texas**
Apical sternite with apex decidedly trianguloid (Fig. 17); penis valve (Fig. 24), with lateral raised portion wider, and the apex of the ventro-mesal lobe almost semicircular ..... **sialica**
17. Volsellae with dorsal aspect large and very broad, the sagittae normal but appearing small by comparison (Figs. 1, 2) ..... **spala**
Volsellae with dorsal aspect smaller (Fig. 3), not very much larger than the sagittae 18
18. Dorsal membranous flap of penis valves wide and setose, apical third of ventral margin of valves concave (Fig. 32) ..... **pallipes**
Dorsal membranous flap of penis valves either very narrow (Fig. 33) or not setose (Fig. 34), apex of valves with ventral margin slightly convex 19
19. Apical sternite broad and nearly truncate at tip (Fig. 18) ..... **idaho**
Apical sternite tapering to a narrow tip (Fig. 19) ..... **nalema**
20. Lancet without definite spurettes (Fig. 42) and with deep segments; lance with basal segment short and bell-like 21
Lancet either with definite, well-developed spurettes (Figs. 45–59) or basal segment of lance with a fairly long portion before the basal constriction (Fig. 48) 23
21. Central lobes of lancet close together, the apical tooth of one close to the basal end of the preceding lobe (Fig. 43) ..... **texas**
Central lobes of lancet separated by nearly their own length (Figs. 42, 44) 22
22. Lancet with lobes high and fairly close together (Fig. 44) .... **makila**
Lancet (Fig. 42) with lobes lower and farther apart ..... **sialica**
23. Central and basal segments of lancet almost twice as high as long, similar in shape to figure 42, spurettes small, and lancet with 20–21 segments (Fig. 45) ..... **bioculata**
Either central and basal segments only slightly higher than long or lancet with less than 18 segments (Fig. 46); spurettes frequently large (Figs. 47, 59) 24
24. Lance narrow and tapering evenly from near middle to a long, sharp apex (Fig. 57); malar space very long (Fig. 35) ..... **lacteipennis**
Lance wider (Fig. 55) sometimes tapering suddenly from a point much nearer apex (Fig. 56); malar space shorter (Figs. 36, 37) ..25

25. Ventral lobes of lancet with a series of fine teeth (Figs. 46, 48–51) the basal tooth neither greatly enlarged nor forming an anvil-like projection with the preceding tooth.....26
Ventral lobes with coarser teeth (Fig. 52) sometimes with the basal tooth greatly enlarged (Fig. 47), or with the basal tooth and the preceding one forming an anvil-like projection (Figs. 58, 59)....30
26. Lancet with only minute spurettes situated at base of ventral lobes (Fig. 46).....**oskina**
Lancet with spurettes long and sharp on central segments (Figs. 49–51) or situated some distance from base of ventral lobe (Fig. 48).....27
27. Lancet with spurette scarcely projecting beyond basal tooth of ventral lobe, on central segments the two appearing as sister teeth (Fig. 50).....**alpestris**
Lancet with spurette projecting considerably beyond basal tooth of ventral lobe (Figs. 49, 51).....28
28. Lancet with sclerotized portion of spurette minute (Fig. 48). **stricklandi**
Lancet with spurette larger, its base close to basal tooth (Figs. 49, 51).....29
29. Lancet with toothed area of ventral lobes sloping at a more gentle angle, usually with 8 teeth, the basal tooth not projecting more than in figure 51.....**pallipes**
Lancet with toothed area of ventral lobes sloping at a greater angle, usually with only 4–6 teeth on central segments, the basal tooth projecting more conspicuously (Fig. 49).....**halcyon**
30. Lancet with basal tooth of ventral lobes produced into a very long tooth, the apical teeth low and regular (Fig. 47).....**ritcheri**
Lancet with basal tooth of ventral lobes not so long and narrow (Fig. 52) or apical teeth much more prominent (Fig. 53).....31
31. Head and body entirely straw-color, eyes and sometimes antennae black.....32
At least a black area at base of abdominal tergum; sometimes almost entirely black.....34
32. Lance tapering evenly from near middle (Fig. 55); lancet with spurettes very large, triangular and on central segments situated very close to and slightly overlapping basal tooth of ventral lobe (Fig. 55B).....**oregonensis**
Lance narrowed suddenly near apex (Fig. 54); lancet with spurettes smaller, none of them overlapping basal tooth of ventral lobe (Figs. 54, 56).....33
33. Basal segment of lance very long (Fig. 54); lancet with alar spines distinct on 6 basal segments; spurettes round at tip.....**nalema**
Basal segment of lance short (Fig. 56); lancet with alar spines distinct on 4 basal segments; spurettes sharp at tip.....**idaho**

34. Lancet with ventral lobes modified to form projecting cusped teeth set far apart and without intervening small teeth (Fig. 59). **testudinea**

Lancet with ventral lobes not forming such projecting teeth, either with low, long, anvil-like teeth (Fig. 58) or with apical teeth distinct on central lobes (Fig. 52) 35

35. Ventral lobes of lancet with basal tooth and the preceding tooth forming a low, long anvil-like tooth, the other teeth reduced and irregular (Fig. 58) ..... **montanicola**

Ventral lobes of lancet with teeth forming nearly regular series, not modified to form anvil-like structures (Figs. 52, 53) 36

36. Lancet with segment 3 toothed as distinctly as 4, segments 12 and 13 well separated; spurettes well separated from ventral margin (Fig. 52) ..... **cookei**

Lancet with segment 3 only faintly toothed, segments 12 and 13 small and almost completely coalesced; spurettes close to ventral margin (Fig. 53) ..... **marlatti**

Hoplocampa sialica new species (Figs. 17, 24, 42.)

This species is closely related to *texas* Ross, but differs in genitalic characters as outlined in the key.

Male.—Length 6.0 mm. Head, body and appendages bright reddish yellow with the following parts almost black: eyes, ocellar triangle, metanotum, and a few adjacent parts of the mesonotum, dorsal lines on the pleurae and an irregular area on the basal abdominal tergite; wing veins mostly brown. Malar space one-seventh dorso-ventral length of eye. Dorsum of head and thorax fairly closely and minutely pitted, both shining. Ninth sternite (Fig. 17) with the apical portion definitely angular.

Genitalia with apical segment of claspers fairly long, their mesal margin nearly straight. Lobes of parapenis large, suddenly narrowed at apex to form a lateral lobe similar to figure 11. Volsellae and sagittae of moderate size, both rounded at apex. Penis valves (Fig. 24) somewhat curved, with a long body and comparatively short leg; the lateral area bearing sense pores and minute setae, form a raised portion which reaches the tip of the valve in the form of a narrow point; the mesal membranous lobes form a rounded ventral lobe and a long wide dorsal flap which is narrowed toward the base and which is covered with abundant microtrichia.

Female.—Size, color and general structure similar to male except for the antennae and tarsi, which are suffused with brown. Saw very broad. Lance deep with 17 segments tapering gradually from near middle to a pointed apex. Lancet (Fig. 42A) with 18 segments, all but the apical four or five set off by distinct unarmed sutures, some of which terminate in a very slight curve which represents a rudimentary spurette. Ventral lobes (Fig. 42) fairly low, the basal portion slightly curved, each lobe with 8 to 10 very minute teeth.

Holotype.—Male; Ithaca, New York; May 8, 1898; [INHS].
Allotype.—Female; same data; [INHS].
Paratypes.—1 ♀; same data as for holotype; [INHS]. 1 ♀ with no data, bearing a small disc, and the label *"Selandria halcyon* Harris"; [ANSP].

Hoplocampa makila new species (Fig. 44.)

This species superficially resembles such Western species as *pallipes* and *montanicola* in color and sculpturing, differing from these, however, in the very broad saw with narrow and deep segments on both lance and lancet. It is most closely related to *sialica* Ross, differentiated by the lower projecting ventral lobes and shorter lancet segments.

Female.—Length 6.0 mm. General color brownish yellow; most of sutures brown; eyes black; antennae with basal six segments dark brown shading beyond these points to a yellowish tip; irregular areas around ocelli dark brown; thorax with anterior edge of praescutum, irregular lines on propleurae and prosternum, most of pectus, lower portion of mesopleurae and areas along sutures of metanotum, black; abdomen with a large black patch on dorsum, most of the basal sternites and almost all the sheath, dark brown to black; wings hyaline, with many of the veins dark brown. Malar space narrow, only one-ninth as long as dorso-ventral length of eye. Dorsum of head and thorax minutely pitted but shining. Saw with segments very deep and narrow. Lance with 19 segments, the apical 8 tapering to form a long triangular apex. Lancet (Fig. 44), with 20 segments, all but the apical four separated by distinct, unarmed sutures; ventral lobes of central segments projecting so that the basal side is nearly at right angles to the ventral margin of the lancet, each lobe with a series of very fine teeth, the lobes separated by only a short distance; spurettes absent on most segments but on others represented by only a slight angulation of the intersegmental sutures.

Holotype.—Female; Klamath Falls, Oregon; May 13, 1924; [INHS].

Hoplocampa texas new species (Figs. 6, 11, 23, 43.)

This species is most closely related to *sialica* Ross. In the female the difference is in having the ventral lobes of the lancet almost confluent, without any distinct interval between them. In the male the truncate apical sternite is diagnostic.

Male.—Length 4 mm. Color yellowish buff, with the lobes of the mesoscutum, indistinct areas on praescutum, and the entire abdominal tergum

black; wings medium brown infuscate. Malar space short, about one-seventh as long as dorso-ventral length of eye. Clypeus deeply, arcuately emarginate. Head and body shining, head faintly punctate. Apical sternite with apex wide and truncate, with a slight median production (Fig. 18).

Genitalia with apical segment of claspers long and rounded at apex. Parapenis (Fig. 11) moderately short, apex with a lateral prolongation. Apex of sagittae triangular, about equal in size to rounded apex of volsellae (Fig. 6). Penis valves (Fig. 23) without digitate processes, glandular portion raised above mesal plane and reduced apically to a rounded point; dorsal lobe with microtrichiae at apex, dorsal margin sinuate.

Female.—Similar in size, color and general structure to male. Saw with 18 segments in lance and lancet. Lancet (Fig. 43) without lateral armature, sutures distinct except for apical three or four segments. Ventral lobes projecting considerably, with about five rounded teeth; the lobes confluent with each other and much reduced in size at base of saw.

Holotype.—Male; Wolfe City, Texas; March 27, 1907; (F. C. Bishopp; on *Crataegus* sp.); [INHS].

Allotype.—Female; same data; [INHS].

Paratypes.—2 ♂; Wolfe City, Texas; April 24, 1906; (F. C. Bishopp; on Haw blossoms (*Crataegus*)).

Deposited in the collections of the Illinois Natural History Survey and The Academy of Natural Sciences of Philadelphia.

The collection data "on Haw blossoms" indicates that the larvae of this species may feed in young fruits of *Crataegus*.

Hoplocampa bioculata Rohwer (Figs. 5, 25, 45.)

1908. *Hoplocampa bioculata* Rohwer, Can. Ent., XL, p. 179. (♀.) [Type No. 13470, USNM.]

1911. *Hoplocampa koebelei* Rohwer, U.S.D.A., Bur. Ent., Tech. Ser., no. 20, (4), p. 142. (♀.) [Type No. 13472 USNM.] *New synonymy.*

1923. *Hoplocampa padusa* MacGillivray, Bull. Univ. Ill., XX, (50), p. 17. (♂.) [Type in Univ. Ill.] *New synonymy.*

This species is distributed through the western states but has not been reported east of the Rocky Mountains. Collection records indicate that the larvae feed in fruits of *Amelanchier*.

Male.—Length 5 mm. Head and body variegated with black and yellow; head yellow with black markings on frons, ocellar region, and with most of posterior aspect black; thorax black with pronotum, lateral areas of praescutum and large areas of mesopleurae yellow; abdomen with tergites banded with yellow and black, the bands fading out at the apex, the sternites mostly black, with the apical two almost entirely yellow; antennae yellow with the two basal segments brown; legs almost entirely yellow except for

irregular black marks at the base; wings hyaline, costa and stigma yellow, remainder of venation dark brown. Dorsum of head and mesonotum dull with fine shagreening. Ninth sternite at apex wide and squarely truncate.

Genitalia with apical segment of claspers fairly short, the ventro-mesal margin gently concave. Lobes of parapenis with a rectangular basal portion which is constricted to form an ear-like apical lateral process similar to figure 10. Volsellae with apical portion short, constricted at tip, sagittae (Fig. 5) very wide, the apical margin flat and sloping gently surmounted by a very small point. Penis valves (Fig. 25) elongate and straight, with a raised lateral portion which does not reach the apex of the valve; dorsal mesal membranous lobe very narrow and with only scattered and minute microtrichiae.

Female.—Length 6 mm. Color almost entirely black except for the following areas which are brownish yellow: narrow areas around eyes, stripe between upper margin of eyes and post ocellar areas, clypeus and mouth parts, and general aspect of antennae; most of front and middle legs and indistinct banding of posterior tarsi; sometimes markings on the pronotum; wings entirely hyaline with venation dark brown. Head dull as in male. Saw similar in general shape to figure 42A, having narrow and deep segments in both lance and lancet. Ventral lobes (Fig. 45) high, with an even, sloping apical margin with six to eight very fine teeth, each lobe set off from the rest by a flat and toothless interval; spurettes small but distinct, projecting from the base of each ventral lobe.

The types of *bioculata,* collected from various localities in Colorado, represent the darker extreme in the color of the species. The type of *koebelei* from Oregon is slightly lighter, having the light area around the eyes and the yellow on the legs slightly more extensive. The types of *padusa* are males from Corvallis, Oregon, and represent typical members of the male sex.

Distribution Records.—Specimens examined 87; 32 ♂, 55 ♀.

British Columbia: 9 ♂, 4 ♀; Salmon Arm; April 29–May 7, 1931, 1932, 1933; at flowers of *Amelanchier cusickii;* (Hugh B. Leech); [HBL]. 1 ♂, 1 ♀; Vernon; April 8, 1934; [INHS].

California: 4 ♀; Modoc National Forest, Hackamore; May 5, 1934; (K. A. Salmon; on flowers of *Amelanchier alnifolia*); [KAS]. 3 ♂, 3 ♀; Modoc National Forest, Happy Camp; May 6, 1934; (K. A. Salmon; on flowers of *Amelanchier alnifolia*); [KAS]. 1 ♀; Truckee; June 17, 1927; (E. P. Van Duzee); [CAS].

Colorado: 5 ♂, 15 ♀; "Colo," acc. 2208, [USNM]. 2 ♀, same data; [types of *bioculata,* USNM].

Oregon: 2 ♂, 3 ♀; Corvallis; April 18, 1936; (G. Ferguson); [OAC, INHS]. 4 ♂; Corvallis; (A. L. Lovett); [types of *padusa,* UI]. 1 ♀; "Ore"; (Koebele); [type of *koelebei,* USNM].

UTAH: 1♀; Logan Canyon; May 16, 1934; (T. O. Thatcher); [INHS]. WASHINGTON: 1♀; Almota; April 17; [WAC]. 1♂, 3♀; Kettle Falls; May 3, 1912; [WAC]. 3♂, 10♀; Pullman; April 17–June, 1909, 1921; (H. Lockhart, W. M. Mann, C. V. Piper); [WAC]. 1♂, 1♀, Union Flat; May 14, 1922; [INHS]. 2♂, 5♀; Wawawai; April 17–May 28, 1917, 1922; [WAC]. 1♂; Wenatchee; May 8, 1880; [WAC].

Hoplocampa oskina new species (Figs. 27, 46.)

Color and general structure of this species is similar to *ritcheri* Ross but differs in the short basal teeth of the lancet of the female and the short apical process of the male penis valve.

Male.—Length 6.0 mm. Color mostly black with the following parts brownish yellow: lower part of head, suffused areas around eyes, apical half of antennae; legs with all tarsi, most of front and middle tibiae and irregular areas on knees and trochanters straw colored. Wings slightly stained with brown, the venation mostly light brown, including costa and stigma. Head with malar space very short, one tenth dorso-ventral length of eye. Dorsum of head and thorax shining but conspicuously pitted over the entire surface with close punctures. Ninth sternite with apical margin wide and nearly truncate, with small mesal projection similar to figure 15.

Genitalia with apical segment of claspers long and broad, their mesal margin straight. Lobes of parapenis fairly broad and long, narrowed at apex to form lobes slightly wider than in figure 14. Volsellae and sagittae of the common type illustrated in figure 6. Penis valves (Fig. 27) long and straight, with a short leg and small foot, the apical portion elongate, rounded and fairly wide at apex; from the dorsal side of the apex a pointed finger projects which is entirely surrounded by a membranous sleeve which continues basad to form the meso-dorsal flap; this flap is fairly wide and clothed with abundant microtrichiae.

Female.—Length 6.5 mm. Color almost entirely chestnut brown with the following few exceptions: eyes, sutures of propleurae and convexities of metathorax, black; tibiae and tarsi of legs straw colored, the hind tibiae brownish towards apex; wings very faintly stained with yellow, most of the venation light brown. General structure as for male.

Saw with lance and lancet fairly shallow, each of about the same depth, lance with 16 segments, the lancet with 17 segments. Lance (Fig. 46) with about 11 distinct segmental sutures, with center segments about one and one-half times as high as long; ventral lobes only moderately produced with a small number of fine teeth and with a small spurette at the base of each lobe.

Holotype.—Male; White Heath, Illinois; May 1, 1932; (Paul Ritcher); [INHS].

Allotype.—Female; same data; [INHS].

Paratypes.—Illinois: 16 ♂, 10 ♀; St. Joseph; May 3–4, 1914; along Salt Fork River. 22 ♂, 36 ♀; White Heath; May 1–18, 1907, 1917, 1932, 1933; (Ritcher, Ross). 6 ♂, 3 ♀; Urbana; April–May 5, 1915, 1932, 1935; (Ritcher, Ross). 3 ♂, 1 ♀; Mahomet; May 8, 1932; (Ross & Mohr). 1 ♀; Havana, Chautauqua Park; April 29, 1914. 2 ♀; Minier; May 8, 1932 (Ross & Mohr). 2 ♀; Mt. Carmel; April 19–20, 1932; (Ross & Mohr). 2 ♀; Monticello; May 7, 1936; (Ross & Burks). All [INHS, ANSP]. Kansas: 1 ♂; Riley Co.; April 25; (J. B. Norton); [INHS]. Michigan: 1 ♂, 3 ♀; Bay Co.; June 2, 1940; (C. W. Sabrosky); [CWS, INHS]. 2 ♀; Midland Co.; June 5, 1937; R. R. Dreisbach; [RRD, INHS].

The material collected in 1932–35 from various localities in Illinois was taken from flowering trees of *Crataegus mollis,* one of the common flood plain species of *Crataegus* in central Illinois. Although further biological studies were not made, there seems little doubt but that the larva of the species feeds in the developing *Crataegus* fruits. In Urbana and neighboring localities in Illinois the sawfly adults were very numerous around *Crataegus* flowers in 1932, but subsequent collections in the following years netted only a small number.

Hoplocampa ritcheri new species (Figs. 20, 47.)

The curious penis valves of this species (Fig. 20) and the distinctive long basal tooth of the ventral lobe of the female saw (Fig. 47) distinguish this species at once from all other members of the genus. It is probably most closely related to *oskina* Ross, with which it has been collected, but in this latter species the genitalia are entirely different.

Male.—Length 4 mm. Head orange-yellow with brown markings on dorsum of antennae; body black; legs with femora more or less black, remainder varied orange-yellow to brown. Wings hyaline, barely tinged with brown. General structure similar to *oskina,* with differences in the following structures: apical sternite practically truncate, very slightly produced on meson, as in figure 18.

Apical segment of claspers oblique, round at apex. Sagittae tapered and angled slightly laterad at apex, as high as the volsellae, which have a rounded apex. Lobes of parapenis very similar to *texas* Ross (Fig. 11). Penis valves (Fig. 20), with the apex produced into a thin, submembranous process which angles mesad and bears a single stout spine near base of

lobe; lateral aspect of valve (Fig. 20B) with widened apical portion quite short, the leg appearing very long and widened at base into a large foot; dorsal membranous lobe very large, with only extremely minute setae, for the most part so transparent that it is difficult to distinguish.

Female.—Size and general structure as in male. Color entirely chestnut. Sheath long, blade-like and pointed. Saw (Fig. 47A) with 14 differentiated segments in lance, 16 in lancet. Lancet (Fig. 47B) with ventral lobes prominent, their basal tooth long slender and pointed, preceded by about seven small teeth, and with a long spurette situated near the base of the ventral lobes.

Holotype.—Male; White Heath, Illinois; May 1, 1932; (Paul Ritcher); [INHS].

Allotype.—Female; same data; [INHS].

Paratypes.—ILLINOIS: 3 ♂, 4 ♀; White Heath, same data as holotype. 1 ♂, 1 ♀; Urbana; April and May 5, 1932, 1935; (H. H. Ross; on *Crataegus*). 1 ♀, Minier; May 8, 1932; (Ross & Mohr); [INHS, ANSP]. NORTH CAROLINA: 1 ♂, 1 ♀; Summit of Black Mts.; July 2–5, 1906; (W. Beutenmuller); [INHS]. WASHINGTON: 2 ♂; Oroville; [WAC, INHS].

The Illinois material of this species was collected along with specimens of *oskina* on flowers of *Crataegus mollis.* Compared to *oskina,* this species was quite rare. Presumably its larvae feed in the developing fruits of *Crataegus.*

Hoplocampa stricklandi new species (Figs. 3, 13, 31, 48.)

This species is most closely related to *pallipes* MacGillivray, differing from it and other related species in the ventral thumb of the penis valve of the male and the saw of the female (Fig. 48) which has the spurettes long but with only the tip sclerotized.

Male.—Length 6.0 mm. Color a light, bright, brownish yellow with the following parts black: eyes, minute circles around each ocellus, metanotum and adjacent areas of mesonotum, and irregular areas on the basal four or five abdominal tergites. Malar space one-eighth of dorso-ventral length of eye. Dorsum of head and thorax shining but with abundant minute pits. Ninth sternite with apex only slightly angular, almost exactly as in figure 17.

Genitalia with apical segment of claspers short, their mesal margin straight. Lobes of parapenis somewhat triangular, narrowed at apex to form a thumb-like tip (Fig. 13). Apex of volsellae with dorsal aspect (Fig. 3A) rounded and fairly narrow; lateral aspect (Fig. 3B) also rounded but very wide; sagittae small, fairly long, narrow and pointed. Penis valves slightly sinuate (Fig. 31) with leg short and slender; body fairly wide,

pointed at apex, with a sclerotized, finger-like process on dorsal margin near apex and wide, membranous ventral flap covered with abundant microtrichiae.

Female.—Length 7 mm. Color identical with that of male except for the antennae which are suffused with brown. Lance (Fig. 48A) with 13 segments, the apical five or six tapering gradually to a point. Lancet with 14 segments, the basal four set off by toothed sutures, the next three or four by weak unarmed sutures, the remaining apical segments without sutures. Ventral lobes (Fig. 48B) composed of a fairly long sharp basal tooth and a long series of fine apical teeth; spurettes distinct, long and sharp, but with only a small apical portion sclerotized, and situated some distance basad of the ventral lobe.

Holotype.—Male; Beaverlodge; Alberta; May 28, 1931; (E. H. Strickland); [INHS].

Allotype.—Female; same data; [INHS].

Paratypes.—2 ♂; same data as for holotype; [CNM, INHS]. 1 ♀; Gull Lake, Alberta; June 8, 1929; (E. H. Strickland); [CNM]. 1 ♂, 1 ♀; Mio, Michigan; May 29, 1927; [INHS, ANSP]. 1 ♀; Pincher, Alberta; May 20, 1932; (E. H. Strickland); [INHS].

Hoplocampa halcyon (Norton) (Figs. 8, 29, 49.)

1861. *Selandria halcyon* Norton, Proc. Bost. Soc. Nat. Hist., VIII, p. 222. (♂, ♀.) [Type No. 14902, MCZ.]

1867. *Selandria halcyon* Norton, Trans. Amer. Ent. Soc., I, p. 252.

1911. *Hoplocampa* (*Hoplocampa*) *halcyon* (Norton), Rohwer, U.S.D.A., Bur. Ent., Tech. Ser., no. 20, (4), p. 145.

1911. *Hoplocampa* (*Hoplocampa*) *xantha* Rohwer, U.S.D.A., Bur. Ent., Tech. Ser., no. 20, (4), p. 144. (♀.) [Type No. 13478, USNM.] *New synonymy.*

1927. *Hoplocampa halcyon* (Norton), Bird (in part), Ann. Ent. Soc. Amer., XX, p. 484. (Larva.)

The range of this species appears to embrace the northeastern portion of the United States and adjacent Canada, with records from Virginia and Maryland to the south and Illinois and Manitoba to the west. The species feeds in the fruits of *Amelanchier*.

Male.—Length 6.0 mm. Head, body and appendages brownish yellow, the eyes, area between ocelli, irregular areas on meso and metanotum and most of the abdominal dorsum except the apex, varying to medium dark shades of brown; wings hyaline, costa and stigma straw color, remainder of venation mostly brown. Head and mesonotum shining, practically without punctures. Malar space one-eighth dorso-ventral length of eye. Apical sternite somewhat produced and pointed, very similar to figure 19.

Genitalia with apical segment of claspers fairly long, their mesal margin almost straight. Lobes of parapenis small, the apical one-half narrowed (Fig. 8). Volsellae and sagittae both fairly large and narrowed at apex, very similar to figure 6. Penis valves with relatively short leg and small foot, the main body evenly expanded toward apex, the extreme tip terminating in a slight rounded elevation; dorso-mesal membranous lobes wide and densely clothed with microtrichae.

Female.—Length 6.5 mm. Color similar to that of male, with the following slight differences: antennae usually brown, mesonotum frequently bright brownish yellow. General structure as for male. Saw with 14 segments in the lance, 15 in the lancet, lance fairly deep, markedly bowed and tapering fairly evenly to narrow apex similar in shape to that in figure 42A. Lancet (Fig. 49) with central segments only slightly deeper than long; ventral lobes projecting sharply from segments, the apical margin with 4 to 6 teeth, the entire ventral lobe fairly similar in size and shape to the spurettes, which are conspicuous and project considerably basad of the lobes.

The type of this species is a male bearing the label "M[arylan]d." *H. xantha* Rohwer represents the female of this species; of the four females comprising the type series, collected at Ottawa, Canada, only the holotype belongs to this species; the remaining three paratypes are *montanicola* Rohwer. Few extensive collections of the species have been made.

Distribution Records.—Specimens examined 40; 18 ♂, 22 ♀.

ALBERTA: 1 ♂; Beaverlodge; May 21, 1931; (O. Peck); [INHS]. 1 ♂; Edmonton; May 28, 1926; (E. H. Strickland); [EHS].

ILLINOIS: 2 ♂; Mahomet; April 22, 1918; (T. H. Frison); [INHS].

MAINE: 1 ♂; [ANSP].

MANITOBA: 3 ♀; Aweme; May 11–June 26, 1925, 1937; (R. D. Bird); [RDB, CNM, INHS].

MARYLAND: 1 ♂; "Md"; [type of *halcyon*, MCZ].

MASSACHUSETTS: 2 ♂, 2 ♀; Boston; May; [INHS, ANSP]. 1 ♂; Riverside; June 13; [INHS].

MICHIGAN: 1 ♀; Bay Co.; June 2, 1940; (C. W. Sabrosky); [CWS]. 1 ♂, 3 ♀; Clare Co.; May 22, 1937; (R. R. Dreisbach); [RRD]. 1 ♀; Houghton, May 29, 1937; [INHS]. 1 ♂, 3 ♀; Midland Co.; May 10, 1935; (R. R. Dreisbach); [RRD]. 2 ♀; West Branch; May 29, 1937; [INHS].

NEW JERSEY: 1 ♂; Clementon; April 25, 1909; [INHS]. 1 ♂; Glassboro; April 30, 1911; [USNM].

NEW YORK: 2 ♂, 3 ♀; Karner; May 12–14, 1903, 1906; [NYS, INHS].

NORTH CAROLINA: 1 ♂, 1 ♀; Burgaw; April 3, 1914; (C. L. Metcalf); [INHS].

ONTARIO: 1 ♀; Ottawa; [type of *xantha*, USNM].

QUEBEC: 1 ♀; Covery Hill; May 31, 1924; (T. Armstrong); [CNM].

VIRGINIA: 1 ♂, 1 ♀; Falls Church; April 20–30, 1920, 1930; [USNM].

Hoplocampa pallipes MacGillivray (Figs. 32, 51.)

1893. *Hoplocampa pallipes* MacGillivray, Can. Ent., xxv, p. 239. (♀.) [Type in Univ. Ill.]

1911. *Hoplocampa* (*Hoplocampa*) *nevadensis* Rohwer, U.S.D.A., Bur. Ent., Tech. Ser., no. 20, (4), p. 143. (♀.) [Type No. 13475, USNM.]

This species is one of the most common in the genus in the western states. The range, however, extends eastward to Michigan, although records east of the Rocky Mountains are infrequent.

Male.—6 mm. Color and general structure practically identical with *halcyon* (Norton). Penis valves (Fig. 32) distinctive; leg and foot short, the main body curved ventrad; terminating in an oblique apical margin with a high rounded ventral corner; dorso-mesal lobe fairly wide, clothed with abundant microtrichae.

Female.—Size, color and general structure, including most of the characters of the saw, as in *halcyon.* Diagnostic differences apparently confined to the lancet (Fig. 51) which has the ventral lobes sloping gradually, each with eight or more fine teeth, the spurettes large and projecting considerably basad of basal tooth.

Allotype.—Male; Pullman, Washington; May; [INHS].

The type of *pallipes,* collected at Skokomish River, Washington, May 8, 1892 on *Amelanchier,* T. Kincaid, and the type of *nevadensis,* collected in Nevada, are both females. There is some color variation in this species but it does not approach the range found in such species as *montanicola.*

Distribution Records.—Specimens examined 76; 40 ♂, 36 ♀.

ALBERTA: 1 ♂; Pincher; May 20, 1932; (E. H. Strickland); [EHS].

BRITISH COLUMBIA: 1 ♂, 1 ♀; Salmon Arm; April 29, 1931; (Hugh B. Leech); [HBL]. 2 ♀; Vancouver; May 15, 1933; (G. R. Hopping); [GRH]. 1 ♂, 2 ♀; Vernon; April 18, 1934; (G. R. Hopping, H. B. Leech); [GRH, INHS].

CALIFORNIA: 1 ♂; Alameda; June; [CAS]. 3 ♂, 2 ♀; Lagunnitas, Maria Co.; April 26, 1924; (E. P. VanDuzee); [CAS]. 1 ♂; Leona Heights; May 5, 1918; [CAS]. 2 ♂, 2 ♀; Modoc National Forest, Hackamore; May 5, 1934; (K. A. Salman); [INHS, KAS]. 1 ♂, 3 ♀; Modoc National Forest, Happy Camp; May 6, 1934; (K. A. Salman); [INHS, KAS].

IDAHO: 1 ♂, 1 ♀; Worley; May 14, 1933; (R. D. Shenefelt); [WAC].

MICHIGAN: 3 ♂, 2 ♀; Midland Co.; May 14–25, 1935, 1937; (R. R. Dreisbach); [RRD, INHS].

MINNESOTA: 1 ♀; Case Co.; May 23, 1936; (H. H. Daggy); [UM].

NEVADA: 1 ♀; "Nev."; [type of *nevadensis,* USNM].

NEW YORK: 1 ♂; Albany; May 8, 1889; [NYS].

OREGON: 1♂, 1♀; Cornelius; May 15, 1938; (Schuh & Gray); [OAC]. 1♂; Corvallis; April 7, 1930; (L. G. Hudson); [INHS]. 1♀; Koebele; [USNM].

UTAH: 1♀; Logan Canyon; May 16, 1934; (T. O. Thatcher); [INHS].

WASHINGTON: 2♂; Kettle Falls; May 3, 1912; [WAC]. 1♀; Oroville; [WAC]. 19♂, 12♀; Pullman; April–May 28, 1908; (M. C. VanDuzee, C. V. Piper); [WAC, CAS, INHS]. 1♀; Skokomish R.; May 8, 1892; on *Amelanchier;* (T. Kincaid); [type of *pallipes,* UI].

WYOMING: 2♀; Union Flats; May 14, 1922; (A. L. Melander); [INHS].

Hoplocampa neneti new species (Figs. 7, 28.)

This species is related to *halcyon* (Norton), but is readily distinguished from that species and all others in the genus by the curious hatchet-shaped penis valves and the sinuate mesal margin of the claspers. I have seen only a single specimen of this species and that has no head, but the characters of the genitalia are so distinctive that the species warrants description at this time.

Male.—Length about 5.0 mm. Color reddish brown with the central areas of the praescutum, dorsal areas of the pleurae, lateral areas on the posterior part of the mesonotum, all of the metanotum, and most of the dorsum of the abdomen, black; wings with most of the veins brown. Dorsum of thorax shining. Ninth sternite with apical portion concave at sides, the apex evenly rounded and wide.

Genitalia with apical segment of claspers long and sinuate, the mesal margin produced into a hump near apex (Fig. 7). Parapenis small, the apices divergent and narrowed. Volsellae and sagittae of moderate size, apex of volsellae and sagittae narrow and pointed. Penis valves (Fig. 28) straight, with a long narrow foot; the apical portion, has a moderate incision between the ventral sclerotized area which bears the sense pores and the dorsal membranous flap; this flap extends the entire length of the body of the valve, is covered with microtrichiae and is produced at the apex into a prominent lobe, the entire structure thus appearing somewhat hatchet-like.

Holotype.—Male; June 20; associated with other specimens from Hull and Ottawa, Ontario, and presumably from one of these localities; [CNM].

Hoplocampa alpestris Rohwer (Figs. 30, 50.)

1911. *Hoplocampa* (*Hoplocampa*) *alpestris* Rohwer, U.S.D.A., Bur. Ent., Tech. Ser., no. 20, (4), p. 142. (♀, ♂.) [Type No. 13474, USNM.]

This species is apparently restricted to the Rocky Mountain region. The female is difficult to distinguish from *pallipes* MacGillivray and *halcyon* (Norton), and it is advisable to verify iden-

tification of females in this group against a reference series the identity of which has been established by association with males. The species are readily separated in the male sex.

Male.—Length 5 mm. Color bright honey yellow with conspicuous black areas as follows: eyes, ocellar region, middle of anterior half of praescutum, most of scutal lobes, with a connecting black band across the meson, declivous areas of meso and metanotum and the central portion of most of the abdominal tergites; antennae and legs entirely honey yellow; wings hyaline, stigma and costa straw color, remainder of venation mostly brown. Head and mesonotum shining with only scattered, minute punctures. Malar space short, only one-tenth dorso-ventral length of eye. Apical sternite and genitalia similar to *halcyon,* the chief differences exhibited by the penis valves (Fig. 30) which have the tip produced into a large rounded projection and have the ventral margin produced into a large round lobe.

Female.—Length 6.0 mm. Color a mottling of yellow and black areas; head honey yellow with eyes, antennae and a large rectangle around the ocelli and between the vertical furrows, black; thorax black with the lateral areas of the pronotum, lateral edges of praescutum, central portion of scutellum, irregular areas on mesopleurae and a few other narrow lines on sutures or creases, yellow; abdomen black with the apical segments and lateral portion of basal segments yellow; legs honey yellow, the hind tarsi brownish; wings hyaline, costa and stigma straw color, remainder of venation mostly brown. Dorsum of head and mesonotum polished. Saw similar in general details to *halcyon,* differeing chiefly in the position of the spurettes, which are situated very close to the base of the ventral lobes and project only slightly beyond the apex of the basal teeth (Fig. 50).

The type series collected at Veta Pass, Colorado, June 6, (E. A. Schwarz), consists of the female holotype and a male and female paratype. This male is without abdomen but the association of the two sexes has been demonstrated by collections from Washington and Alberta.

Distribution Records.—Specimens examined 19; 10 ♂, 9 ♀.

ALBERTA: 3 ♂, 1 ♀; Beaverlodge; May 31, 1931, 1933; [EHS, INHS].

BRITISH COLUMBIA: 1 ♀; Vernon; April 18, 1934; on *Amelanchier* flowers; (H. B. Leech); [CNS].

COLORADO: 1 ♂, 2 ♀; Veta Pass; June 6; (E. A. Schwarz); [types of *alpestris,* USNM].

MONTANA: 1 ♀; Bonner; May 20, 1904; [INHS].

WASHINGTON: 2 ♂, 3 ♀; Kettle Falls; May 3, 1912; [WAC]. 4 ♂; Pullman; April–May 21, 1903; [WAC, INHS]. 1 ♀; Union Flats; May 22, 1914; (A. L. Melander); [INHS].

Hoplocampa cookei (Clarke) The Cherry Fruit Sawfly (Figs. 41, 52.)

1906. *Dolerus cookei* Clark, Can. Ent., xxxviii, p. 351. (♂, ♀.) [Types lost.]

1911. *Hoplocampa* (*Hoplocampa*) *californica* Rohwer, U.S.D.A., Bur. Ent., Tech. Ser., No. 20, (4), p. 143. (♂, ♀.) [Type No. 13471, USNM.]

1918. *Hoplocampa cookei* (Clarke), Rohwer, Proc. Ent. Soc. Wash., xx, p. 167.

Present scant records indicate that this species is restricted to the West and the Rocky Mountain states. It is injurious to cherries, in the fruit of which the larvae develop. The life history and habits have been described by Foster.[5]

Male.—Length 5.0 mm. Head, entire venter of body, antennae and legs almost entirely honey yellow; dorsum of thorax and abdomen almost entirely black, with the following exceptions: head with eyes and small crescents embracing ocelli, black; praescutum with lateral margins yellow; legs with tarsi brown, the posterior pair darkest; wings hyaline, stigma very light brown, remainder of venation almost black. Dorsum of head and mesonotum shining, with fairly abundant minute punctures. Malar space very short, about one-twelfth dorso-ventral length of eye. Apical sternite almost truncate, with a slight mesal projection very similar to figure 18.

Genitalia with apical segment of claspers fairly long, slightly narrowed near tip, the ventro-mesal margin slightly sinuate. Lobes of parapenis very similar to figure 14. Sagittae and volsellae similar to figure 6. Penis valves (Fig. 41) angled at middle, with a long leg and small foot; the main body of the valve is almost parallel sided, its ventral margin slightly concave, the tip nearly truncate and forming a slight dorsal projection from beneath which articulates a long curved tusk-like process.

Female.—Length 5.5 mm. Color almost entirely black except for irregular cream colored areas on the head and legs; wings hyaline, stigma light brown, remainder of venation almost black. General structure as for male. Lance with twelve segments, the basal segment twice as long as deep, the remainder of nearly equal depth except for the apical four which narrow rapidly to a point. Lancet (Fig. 52) with thirteen distinct segments, the apical three set off by spined sutures, the dividing sutures beyond that point disappearing rapidly; ventral lobes of central segments with a relatively small basal tooth and three or four coarse apical teeth; spurettes sharp, situated some distance from ventral margin.

The types of both *cookei* and *californica* were collected at Suisan, California.

Distribution Records.—Specimens examined 13; 7 ♂, 6 ♀.

British Columbia: 1 ♂; Vancouver, April 19, 1933; (Hugh B. Leech; on flowers of *Acer macrophyllum*); [HBL].

[5] Bull. U. S. Bur. Ent., no. 116, 73 pp., (1914).

CALIFORNIA: 1 ♂, 5 ♀; Suisun; Mar. 10, 1910; (R. W. Brancher); [types of *californica,* USNM].

IDAHO: 2 ♂; Worley; May 14, 1933; May 14, 1933; (R. D. Shenefelt); [WAC].

OREGON: 2 ♂; Athena; Wild Horse Mt.; May 14, 1938; (Gray & Shuh); [OAC]. 1 ♀, Corvallis; April 18, 1938; (C. Ferguson); [INHS].

WASHINGTON: 1 ♂, 1 ♀; Pullman; April–May; (A. L. Melander); [INHS].

Hoplocampa marlatti Rohwer (Figs. 14, 40, 53.)

1911. *Hoplocampa* (*Hoplocampa*) *marlatti* Rohwer, U.S.D.A., Bur. Ent., Tech. Ser., no. 20 (4), p. 143. (♂, ♀.) [Type No. 13477, USNM.]

1927. *Hoplocampa halcyon* (Norton) and *xantha* Rohwer, Bird (in part), Ann. Ent. Soc. Amer., xx, p. 484. (Larva.)

Male.—Length 5.0 mm. Color almost entirely honey yellow except for the following areas which are black: eyes, thin lines around ocelli, upper sutures of pleurae, more or less distinct, narrow stripes on scutal lobes, posterior portion of mesonotum and most of metanotum and abdominal dorsum; tarsi light brown, the posterior pair lighter; wings hyaline, costa and stigma straw color, remainder of venation brown. General structure of body and genitalia exactly as for *cookei* (Clarke), diagnostic features confined for the most part to the penis valves (Fig. 40) which differ from *cookei* in being slightly less angular and in having the main body widened near middle and distinctly tapering from that point to the apex, the tip not forming a truncate head over the base of the articulated "tusks." These tusks are not fixed in position so that differences in their position, such as that between figure 40B and figure 41B are of no significance.

Female similar in size, color and general structure to male. Color variation is extensive, usually consisting of additional dark areas on the lobes of the mesonotum which may be black for the most part with yellow lines along the sutures. Saw (Fig. 53) similar in general details to *cookei,* differing in having the two apical segments of the lancet coalesced and in having the spurettes closer to the ventral margin.

Distribution Records.—Specimens examined 47; 23 ♂, 24 ♀.

COLORADO: 3 ♂; "N. Colo."; May 12, 1898; [INHS]. 1 ♂, 1 ♀; [USNM].

ILLINOIS: 1 ♂, 1 ♀; Dubois; April 24, 1914; creek valley; [INHS]. 1 ♂; Homer; April 27, 1907; (Hart & Hood); [INHS]. 1 ♂; Urbana; April 29, 1916; in forestry; [INHS].

IOWA: 1 ♂; Ames; April, 1929; [INHS]. 1 ♀; Appanoose Co.; May 3, 1931; (Humphries); [INHS].

KANSAS: 3 ♂, 1 ♀; Riley Co.; April; (Marlatt); [INHS]. 2 ♂, 2 ♀; same data; [types of *marlatti,* USNM]. 2 ♀; Baldwin; (J. C. Bridwell); [paratypes of *marlatti,* USNM].

MANITOBA: 5 ♂, 8 ♀; Aweme; April 3–June 4, 1912, 1926, 1937; (R. D. Bird); [INHS, RDB]. 2 ♂, 1 ♀; Riding Mountain National Park; June 8, 1937; (R. D. Bird); [RDB].

MICHIGAN: 1♂; Mayfield, Boardman River; May 28, 1939; (Frison & Ross); [INHS]. 3♀; Midland Co.; May 10, 1935; (R. R. Dreisbach); [RRD]. 1♂; Osceola Co.; May 21, 1938, (R. R. Dreisbach); [INHS]. 1♀; Sagimaw County; June 1, 1940; (C. W. Sabrosky); [CWS].

NEW YORK: 1♂, 2♀; Babylon; May 24, 1936; (Blanton & Borders); [INHS]. 1♀; Potsdam; May 23, 1924; [NYS].

Hoplocampa idaho new species (Figs. 12, 18, 34, 56.)

This species and the following appear to be primitive members of a group of species in which the body is pallid, almost cream colored in life. The more specialized members of this group are *oregonensis* (Ashmead) and *lacteipennis* Rohwer. Saw characters of the female and genitalic characters of the male, as outlined in the key, readily separate the species of this group.

Male.—Length 4.5 mm. Head, body and appendages straw color with the following exceptions: eyes and minute crescents around ocelli black, small dorsal patch at base of abdomen brown, tarsi light brown, wing membrane entirely colorless. Head wide, malar space only one-third dorso-ventral length of eye; head and pronotum shining, with very fine and inconspicuous light hair. Ninth sternite with apex wide and nearly truncate, with a very small mesal projection (Fig. 18).

Genitalia with mesal margin of apical segment of claspers evenly arcuate. Lobes of parapenis broad and slightly notched at apex (Fig. 12). Volsellae sinuate, extreme apex narrowed and pointed; sagittae triangular. Penis valves (Fig. 34) straight, relatively narrow, without processes, the apex rounded and lateral margin with an irregular scattering of sense pores.

Female.—Size, color and general structure similar to male except as follows: eight apical segments of antennae dark brown, abdomen entirely straw color, body robust. Lance of saw wide and sinuate (Fig. 56A) the apical three segments tapering suddenly to a sharp point, the lance with 11 distinct segments, the apical one very narrow and pointed and nearly three times as long as the preceding. Lancet (Fig. 56B) with 12 segments; the basal three are set off by nearly complete sutures bearing distinct teeth, the next four are set off by gradually shorter sutures on which the teeth become indistinct, and the remainder of the apical segments are separated only by indentions between the ventral lobes; ventral lobes well separated, the central ones with a fairly long basal tooth and two or three fairly coarse apical teeth; the basal tooth and the preceding apical tooth together forming a small, cusp-like projection; spurettes large, pointed and situated close to or on the ventral margin.

Holotype.—Male; Mt. Moscow, Idaho; June 6, 1930; (H. Waters); [INHS].

Allotype.—Female; same data; [INHS].

Paratypes.—2 ♂; same data as holotype. 2 ♀; Moscow Mts., Idaho; July 10; (R. C. Shannon). 1 ♂; Mt. Spokane, Wash.; June 22, 1930; (J. M. Aldrich).

Paratypes deposited in the collections of the Illinois Natural History Survey, The Academy of Natural Sciences of Philadelphia, and the United States National Museum.

Hoplocampa nalema new species (Figs. 9, 19, 33, 37, 54.)

The tapering ninth sternite of the male and the round spurettes on the lancet of the female distinguishes the species from the preceding, to which it is most closely related.

Male.—Length 5.5 mm. Head, body and appendages entirely straw color except for the eyes, antennae, and a ring around each ocellus, which are black. Head wide, malar space short, equal to slightly less than one quarter of the dorso-ventral length of eye. Clypeus with a wide, obtuse and nearly angular incision. Dorsum of head and thorax minutely pitted but shining. Ninth sternite (Fig. 19) tapering to a somewhat angular apex.

Genitalia with apical segment of claspers nearly as long as in figure 1; mesal margin evenly concave. Lobes of parapenis broad, truncate at apex (Fig. 9). Volsellae and sagittae nearly subequal in size, each slightly more rounded than in figure 6. Penis valves (Fig. 33) long, straight and narrow, without side flaps or projections, the apical portion slightly bulbous and bearing a cluster of sense pores, the lateral margin with a narrow sclerotized band extending from near apex to base of body; leg and foot small.

Female.—Size, color and general structure similar to male except for the robust body. Saw (Fig. 54) in general shaped and proportioned similar to preceding species. Lance broad, with 11 segments, the apical three tapering suddenly, the apical segments long and sharp, nearly three times as long as the preceding. Lancet with 12 segments; the sixth basal segments with sutures usually complete and armed with teeth, next suture partially present but weak, remainder of segments without sutures between them; ventral lobes with a fairly large basal tooth and two to four coarse apical teeth; spurettes distinct on all but the apical two segments, those on the central segments large, round and usually not projecting over ventral margin.

Holotype.—Male; Paradise Park, Mt. Rainier, Washington; August, 1917; (A. L. Melander); [INHS].

Allotype.—Female; same data; [INHS].

Paratypes.—All from Mt. Rainer, Washington; same data as for holotype, 3 ♂; same data but Yakima Park, July 22, 1924, 1 ♂; same data but Alta Vista, July 28, 1922, 1 ♂; same data but Mazama Ridge, July 23, 1922, 1 ♀.

Paratypes are in collections of Illinois Natural History Survey, The Academy of Natural Sciences of Philadelphia and Washington Agriculture College.

Hoplocampa spala new species (Figs. 1, 2, 16, 26.)

The very large volsellae and small pointed sagittae separate this species immediately from all other nearctic members of the genus. It is most closely related to *nalema* Ross as evidenced by the long claspers and simple penis valves.

Male.—Length 5.5 mm. Color almost entirely brownish yellow with the following parts dark brown or black: eyes, minute circles around each ocellus, a few sutures on upper portion of metanotum, posterior portion of lateral lobes of mesoscutum, most of metanotum, and a few lines along sutures of abdomen; in addition to these black areas, the basal segments of the antennae and many veins of the wings are a medium shade of brown. Malar space one-eighth as long as dorso-ventral length of eye. Dorsum of head with very fine punctures and very fine short hair, the two giving it a somewhat velvety appearance; dorsum of thorax similar to, but more shining than, dorsum of head. Ninth sternite tapering at apex (Fig. 16). Genitalia (Fig. 1) with apical segment of claspers very long, their mesal margin very slightly sinuate. Lobes of parapenis long, narrowed and divergent at apex. Volsellae (Fig. 2) with apical portion greatly enlarged, the apico-mesal portion forming a round lobe bearing a cluster of sense cones and hair; sagittae small, their apex forming a narrow sharp point, the entire structure resting in a dorsal excavation of the volsellae. Penis valves short (Fig. 26) slightly curved and of only medium size; their apex has a rounded lateral area bearing sense pores; the dorso-lateral margin is produced into a long membranous flap without distinct microtrichiae.

Holotype.—Male; Vancouver, British Columbia; May 24, 1896; (Livingston); [INHS].

Paratype.—1 ♂; Oregon; (Koebele); [USNM]. This specimen was originally included in the type series of *Hoplocampa occidentalis* Rohwer.

Hoplocampa oregonensis (Ashmead) (Figs. 4, 15, 22, 36, 55.)

1898. *Macgillivraya oregonensis* Ashmead, Can. Ent., xxx, p. 257. (♂, ♀.) [Type No. 12841, USNM.]

To date this species has been recorded only from three northwestern states, Idaho, Montana and Oregon, with no indication of its host species.

Male.—Length 5.5 mm. Head, body and appendages entirely straw color except for the eyes and ocelli which are black or brown; wings entirely

hyaline, the venation almost colorless but with a slightly milky pigmentation. Head with malar space fairly wide (Fig. 36) about one-fifth dorso-ventral length of eye. Dorsum of head and mesonotum shining, with only minute scattered punctures. Apical sternite almost truncate, with a very slight mesal point (Fig. 15).

Genitalia with apical segments of claspers short, rounded at apex, and with mesal margin evenly concave. Lobes of parapenis fairly long, tapering evenly from near middle to a pointed apex. Sagittae and volsellae fairly thin (Fig. 4) the apical lobes of the volsellae concave. Penis valves curved into a marked bow (Fig. 22) the leg very short, the apex enlarged into a somewhat bulbous bent portion; meso-dorsal lobes fairly wide, clothed with fairly abundant microtrichiae.

Female.—Similar in size, color and general structure to male. Saw (Fig. 55) with lance tapering evenly from near middle, containing twelve segments. Lancet containing thirteen segments, with only three or four dividing sutures of which the first three are spined and the fourth is greatly reduced; ventral lobes fairly low with only three or four fairly large apical teeth; spurettes very large, nearly twice as large as basal tooth of ventral lobe and situated close to ventral margin.

The type series, collected from Mt. Hood, Oregon, contains the type female, several female paratypes and a single male allotype. Other material from Mt. Hood and from Moscow Mt., Idaho, substantiates this association.

Distribution Records.—Specimens examined 16; 7 ♂, 9 ♀.

IDAHO: 3 ♂, 3 ♀; Moscow Mt.; July 9–July 17, 1911, 1918, 1920; (A. L. Melander, R. C. Shannon); [INHS, WAC].

MONTANA: 1 ♀; Logan Park; July 12, 1940; (H. H. Ross & J. A. Ross); [INHS].

OREGON: 3 ♂, 3 ♀; Mt. Hood; [ANSP, INHS]. 1 ♂, 2 ♀; same data; [types of *oregonensis*, USNM].

Hoplocampa lacteipennis Rohwer (Figs. 35, 38, 57.)

1910. *Hoplocampa* (*Macgillivrayella*) *lacteipennis* Rohwer, Can. Ent., XLII, p. 244. (♀.) [Type No. 12843, USNM.]

1910. *Hoplocampa* (*Macgillivrayella*) *xanthura* Rohwer, Can. Ent., XLII, p. 244. (♂.) [Type No. 12842, USNM.]

1911. *Hoplocampa* (*Macgillivrayella*) *pallida* Rohwer, US.D.A., Bur. Ent., Tech. Ser., no. 20 (4), p. 141. (♀.) [Type No. 13469, USNM.]

1926. *Hoplocampa* (*Macgillivrayella*) *lacteipennis* Rohwer, Bird, Ann. Ent. Soc. Amer., XX, p. 484. (Larva.)

The range of this pallid species extends from the eastern edge of the Rocky Mountains through southern Canada and northern United States to the Atlantic coast. The larva feeds in the devel-

oping fruits of choke cherry (*Prunus virginiana*); its life history has been discussed in considerable detail by R. D. Bird.[6]

Male.—Length 5.5 mm. Head, body and appendages the same pallid straw color as *oregonensis* (Ashmead), the wings hyaline with milky venation. Head with malar space nearly one-third dorso-ventral length of eye (Fig. 35) the eyes much more reduced than in any other species in the genus. Dorsum of head and mesonotum shining, with only scattered fine punctures. Apical sternite narrowed, very similar to figure 16 but with the extreme tip slightly flattened.

Genitalia with apical segments of claspers long, their mesal margin evenly convex; incision between lobes of parapenis and basal segment of claspers very deep, nearly reaching base of sclerite. Lobes of parapenis long, each curved laterad and narrowed to a fairly sharp point. Sagittae and volsellae fairly small, both with apex rounded. Penis valves (Fig. 38) fairly straight with a long slender leg and small foot, the body of the valve large and broad, with the apical margin oblique and bearing a stout sclerotized spur near the apex; the meso-dorsal flap is scarcely differentiated from the body of the valve.

Female.—Length 6.0 mm. Color and general structure similar to male. Saw (Fig. 57) with lance very narrow, tapering to a long sharp apex, the entire lance composed of fifteen segments. Lancet composed of seventeen segments, the basal eight set off by unarmed sutures; ventral lobes widely separated, with only a few apical teeth, basal tooth of medium size; spurettes fairly small, situated a considerable distance from ventral margin.

This species and *oregonensis* were together considered as a separate subgenus by Rohwer, on the basis of the wider malar space. It seems evident, however, that these two species are closely related to *idaho* Ross and *nalema* Ross, both of which are typical members of *Hoplocampa*. On this basis there is no reason to set up a subgeneric distinction within the genus.

Distribution Records.—Specimens examined 178; 61 ♂, 117 ♀.

ALBERTA: 1 ♀; Edmonton; May 28, 1926; (E. H. Strickland); [EHS]. 2 ♂, 7 ♀; Gull Lake; June 6–14, 1929; (E. H. Strickland); [EHS, INHS].

COLORADO: 2 ♀; Boulder; June 8, 1933; (M. T. James); [INHS, ANSP].

CONNECTICUT: 1 ♀; Killingworth; May 31, 1920; [INHS].

ILLINOIS: 2 ♂, 3 ♀; Cary; May 14, 1936; (Ross & Mohr); [INHS]. 17 ♀; Galena; May 23, 1940; (Ross); [INHS].

MANITOBA: 30 ♂, 37 ♀; Aweme; April 5–June 8, 1925, 1926, 1937; (R. D. Bird); [INHS, RDB, CN]. 1 ♂; Treesbank; May 25, 1926; (R. D. Bird); [RDB].

MASSACHUSETTS: 1 ♀; "Mass."; [type of *lacteipennis,* USNM]. 1 ♀; Wellesley; May 25, 1908; [INHS].

[6] Scientific Agriculture, VIII, pp. 479–501, (1928).

MICHIGAN: 16♂, 17♀; Bay City; May 20, 1936; (Frison & Ross); [INHS, ANSP]. 3♀; Houghton Lake; May 24–29, 1937; (Milliron); [INHS]. 3♀; Lapeer (13 miles N.); May 30, 1938; (C. W. Sabrosky); [INHS]. 2♂; Lovell, Au Sable River, May 22, 1936; (Frison & Ross); [INHS]. 1♂; Midland Co.; May 29, 1935; (R. R. Dreisbach); [INHS]. 2♂, 7♀; No. Branch; May 27, 1939; (C. W. Sabrosky); [CWS]. 1♂, 1♀; Osceola Co.; May 21, 1938; (R. R. Dreisbach); [RRD]. 2♀; Saginaw Co.; June 2, 1940; (C. W. Sabrosky); [CWS]. 2♀; St. Ignace; June 12, 1921; (S. Moore); [INHS]). 1♀; "Michigan"; (C. F. Baker); [type of *pallida,* USNM].

MONTANA: 1♂; "Montana"; [type of *xanthura,* USNM].

MONTREAL: 1♀; Ilede; June 3, 1906; [INHS].

NEW YORK: 1♂, 7♀; Albany; May 16–22, 1910, 1930; (Bigelow, Young); [NYS]. 1♀; Bath; May 20, 1910; (D. B. Young); [NYS]. 1♂; Corinth; May 4, 1916; (Young); [NYS]. 1♀; Ithaca; May 23, 1937; (P. P. Babiy); [INHS]. 1♀; Lancaster; May, 1886; [INHS]. 1♂; Wells; June 10, 1924; (Young); [NYS].

Hoplocampa testudinea (Klug) (Figs. 21, 59.)

1814. *Tenthredo* (*Allantus*) *testudinea* Klug, Magaz. Geo. naturf. Fr. Berlin, VIII, p. 60. [Type probably in Zoological Museum of Berlin.]

This is an Old World species which infests the fruits of apple and has recently been introduced into this continent. At present the sawfly seems confined to small areas, one on the Atlantic coast and one on the Pacific coast, presumably points of introduction. It is impossible to say how rapidly the species will spread from these areas or how abundant it may become. It must be regarded, however, as a definite potential pest of apples. An excellent account of its biology is presented by Miles;[7] especially interesting is his Table 3 showing the differences in infestation for early and late blossoming variety of apples. He notes that for the mid-season blossoming varieties of apples the average infestation of fruits was over 25%, the highest noted in these studies. A few notes are given regarding control measures, together with excellent photographs of the various stages and types of injury.

Male.—Length 7.0 mm. Most of head and entire ventral portion of thorax and abdomen, and all of legs, bright honey yellow; narrow dorsal line on basal segments of antennae, and ocellar region of head, black; the latter black areas extending to eyes; pronotum and tegulae honey yellow, sometimes suffused with brown; entire dorsum of meso and metanotum and abdomen, black. Wings transparent but stained almost uniformly with brown, the entire venation dark brown except for a lighter oval spot toward

[7] Annals of Applied Biology, XIV, pp. 420–31, (1932).

the apex of the stigma. Malar space short, only one-tenth dorso-ventral length of eye. Dorsum of head and mesontoum shining, with minute punctures. Apical sternite nearly truncate, with a slight mesal projection, similar to figure 18.

Genitalia with apical segments of claspers short, lateral aspect almost quadrate, broadened towards apex which is slightly oblique. Lobes of parapenis appearing to be solidly fused on the meson, and forming a fairly small "V." Volsellae and sagittae very similar to figure 6 the apical lobe of the volsellae concave, the apex of the sagittae narrow. Penis valves (Fig. 21) with a very large ventral enlargement, the entire valve of an inverted "L" shape, the leg short, the meso-dorsal flap reduced to a very narrow border.

Female.—Length 7.5 mm. Color almost exactly as for male; sheath black, conspicuous in contrast with the yellow venter and yellow apical tergite. Lancet with seventeen segments, of moderate and uniform depth, except for the apical six segments which taper evenly to a sharp point. Lancet (Fig. 59) very long and slender, with eighteen segments, the basal eight set off by evenly toothed sutures, the sutures gradually fading out beyond this point; ventral lobes reduced to the basal and a single apical tooth, the two together forming a high, more or less anvil-shaped tooth; spurettes long and slender, situated a short distance from the ventral margin.

This species, the largest yet recorded from North America, is apparently constant in color, the pattern setting it off from most species in the genus. Some other species in the genus vary in color to such an extent that this alone does not form a very satisfactory basis of separation but the saw of the female and the male genitalia are so radically distinct in many characters from all others that its identity can be established readily and surely.

Distribution Records.—Species examined 15; 8 ♂, 7 ♀.

BRITISH COLUMBIA: 2 ♂, 2 ♀; Victoria; April 21, 1924; (W. Downes & H. Andison); [INHS].

NEW YORK: 6 ♂, 5 ♀; Long Island; May, 1942; (Pyenson); [INHS].

EUROPE: Recorded generally over western and central Europe.

Hoplocampa montanicola Rohwer (Figs. 10, 39, 58.)

1911. *Hoplocampa* (*Hoplocampa*) *montanicola* Rohwer, U.S.D.A., Bur. Ent., Tech. Ser., no. 20 (4), p. 145. (♀, ♂.) [Type No. 13476 USNM].

1911. *Hoplocampa* (*Hoplocampa*) *orbitalis* Rohwer, U.S.D.A., Bur. Ent., Tech. Ser., no. 20, p. 141. (♀.) [Type No. 13472 USNM.] *New synonymy.*

1911. *Hoplocampa* (*Hoplocampa*) *occidentalis* Rohwer, U.S.D.A., Bur. Ent., Tech. Ser., no. 20, p. 144. (♀, ♂.) [Type No. 13479 USNM.] *New synonymy.*

1927. *Hoplocampa xantha* Rohwer, Bird, Ann. Ent. Soc. Amer., xx, p. 484. Larva.

This species appears to be the commonest species in the genus and is extremely widespread in distribution, its range extending from the Atlantic to the Pacific through northern United States and southern Canada. The larvae feed within the fruit of *Prunus virginiana*. The life history has been studied by Bird under the name of *Hoplocampa xantha* (loc. cit.), who notes that a different fruit is entered by each of the four larval stadia.

Male.—Length 5.0 mm. Color almost entirely honey yellow except for the following black or dark brown areas: eyes, small circles around ocelli, a central triangle on praescutum (this spot sometimes absent), stripes on lobes of mesoscutum (these stripes sometimes absent), posterior sclerite of mesonotum, extreme upper portion of pleurae, almost all of metanotum and a large triangle covering most of the abdominal tergites from the base to the fifth or sixth segments; wings hyaline, costa and stigma pallid, remainder of venation various shades of brown. Malar space of moderate length, about one-fifth dorso-ventral length of eye. Dorsum of head and mesonotum shining, covered with scattered minute punctures. Apical sternite nearly truncate, with a small mesal projection, as in figure 18.

Genitalia with apical segment of claspers long, their mesal margin nearly straight. Lobes of parapenis broad and fairly large, the apico-lateral corners produced into an ear-like process (Fig. 10). Volsellae and sagittae moderately large, similar to figure 6. Penis valves (Fig. 39) with a short leg, the body of the valve long and slender, expanded towards apex which is somewhat bulbous and round and produced into a curved dorsal spine, the pair of spines diverging laterad and fixed in position; meso-dorsal flap fairly wide, and clothed with abundant microtrichiae.

Female.—Length 5.0 mm. Color varying from the light phase similar to that described for the male to a condition in which almost the entire body is black except for the periphery of the head and pale areas on the knees and tibiae of the legs. General structure as for male. Lance of saw with fourteen segments, of moderate and even depth except for the apical four segments which taper to a long sharp point. Lancet (Fig. 58) with sixteen segments, the basal eight with toothed sutures, the sutures fading out beyond this point; ventral lobes represented most conspicuously like long low anvil shaped teeth, each of these consisting of the basal tooth and the first apical tooth; the remaining apical teeth irregular in number and position, and frequently entirely absent between the anvil teeth; spurettes even, about the same size as the basal teeth.

The males of this species show little variation in either color or structural details. The females, however, are extremely variable both in color and in the prominence of the anvil teeth. There seems to be very little correlation between the variation in these characters and all intergrades have been found between the various

extremes. The female types of *montanicola,* labelled "Montana," are of the light phase with flat anvil teeth which are almost identical with figure 58D; the lone female type of *orbalitis,* labelled "Montana," has teeth of the same type but is much darker. The female types of *occidentalis,* labelled "Colorado," are of the pale phase but with well developed dark spots on the mesonotum and have the anvil teeth moderately projecting at each end as in figure 58C; and many specimens from California are almost entirely black and have the ends of the anvil teeth much more projecting (Fig. 58B). On the basis of collection data alone it would appear that the dark color is a melanistic response to high humidity or lower temperature. The elevation of the anvil teeth, however, seems to be correlated most closely with geographic distribution, the more projecting types occurring toward the extreme southwestern part of the species range.

Distribution Records.—Specimens examined 241; 123 ♂, 118 ♀.

ALBERTA: 1 ♀; Gull Lake; June 8, 1929; on *Amelanchier;* (E. H. Strickland); [EHS].

BRITISH COLUMBIA: 1 ♂; Vancouver; May 15, 1933; (G. R. Hopping; on *Amelanchier* flowers); [GRH].

CALIFORNIA: 3 ♂, 4 ♀; Fairfax; May 9, 1920; (E. P. VanDuzee); [CAS]. 6 ♂, 1 ♀; Modoc National Forest, Hackamore; May 5, 1934; (K. A. Salmon); [KAS]. 5 ♂, 1 ♀; Modoc National Forest, Happy Camp; May 6, 1934; (K. A. Salmon); [KAS]. 1 ♂; Placer Co.; June; [USNM].

COLORADO: 2 ♂, 4 ♀; "Colo."; [INHS]. 2 ♂, 3 ♀; "Colo."; [types of *occidentalis,* USNM].

IDAHO: 1 ♂; Burley; June 16, 1931; [USNM]. 1 ♂; Moscow Mts.; June 1, 1907; [WAC].

MANITOBA: 23 ♂, 21 ♀; Aweme; May 20–June 2, 1925, 1937; (R. D. Bird); [RDB, INHS]. 20 ♂, 20 ♀; Riding Mountain National Park; June 9, 1937; (R. D. Bird); [RDB].

MASSACHUSETTS: 15 ♂, 18 ♀; Boston; May; [INHS, WAC]. 1 ♂; Forest Hill; May 3, 1924; [USNM]. 1 ♂; Riverside; May 13; [INHS].

MICHIGAN: 1 ♂; Clare Co.; May 22, 1937; (R. R. Dreisbach); [RRD]. 2 ♂, 3 ♀; West Branch; May 29, 1937; [INHS].

MONTANA: 1 ♂, 3 ♀; [ANSP, INHS, USNM]. 1 ♀; "Montana"; [type of *orbitalis,* USNM]. 2 ♂, 4 ♀; "Montana"; [types of *montanicola,* USNM].

NEW YORK: 6 ♂, 4 ♀; Karner; May 12–23, 1903, 1906, 1907; [NYS, INHS]. 8 ♂, 7 ♀; Niagara Falls; May 17, 1914; M. C. VanDuzee [ANSP, INHS, CAS].

ONTARIO: 3 ♀; Ottawa; [paratypes of *xantha,* USNM].

OREGON: 11 ♂, 10 ♀; Cayuse; May 13, 1938; (Gray & Schuh); [OAC]. 1 ♂; Mosier; May 5, 1938; (Gray & Schuh); [OAC]. 1 ♂, 1 ♀; (Koebele); [USNM].

SASKATCHEWAN: 3 ♀; Oxbow; June 15, 1907; [USNM].

SOUTH DAKOTA: 1 ♂; Brookings; June 28, 1931; (H. C. Severin); [INHS].

UTAH: 1 ♀; Logan Canyon; May 16, 1934; (T. O. Thatcher); [INHS].

WASHINGTON: 7 ♂, 3 ♀; Kettle Falls; May 3, 1912; [INHS, WAC]. 2 ♀; Pullman; April; [WAC].

Hoplocampa flavicornis (Provancher)

1878. *Selandria flavicornis* Provancher, Natural Can., x, p. 100. (♂.) [Type in Quebec Public Museum, Quebec, P. Q.]

I have not studied this type so that I can not place the species. Rohwer, after examining the type, stated that the species was a true *Hoplocampa*.

EXPLANATION OF FIGURES

PLATE VI

Male Genitalia of *Hoplocampa*

Abbreviations Used: acl—apical segment of clasper. bcl—basal segment of clasper. pr—parapenis. pv—penis valves. sag—sagitta. vol—volsella.

Fig. 1.—*Hoplocampa spala* new species. Genital capsule, ventral aspect of right half.
Fig. 2.—*Hoplocampa spala* new species. Volsella and sagitta, dorsal aspect.
Fig. 3.—*Hoplocampa stricklandi* new species. Volsella and sagitta; A, dorsal aspect, B, mesal aspect.
Fig. 4.—*Hoplocampa oregonensis* (Ashmead). Volsella and sagitta, dorsal aspect.
Fig. 5.—*Hoplocampa bioculata* Rohwer. Volsella and sagitta, dorsal aspect.
Fig. 6.—*Hoplocampa texas* new species. Volsella and sagitta, dorsal aspect.
Fig. 7.—*Hoplocampa neneti* new species. Apical segment of clasper, ventral aspect.
Fig. 8.—*Hoplocampa halcyon* (Norton). Parapenis.
Fig. 9.—*Hoplocampa nalema* new species. Parapenis.
Fig. 10.—*Hoplocampa montanicola* Rohwer. Parapenis.
Fig. 11.—*Hoplocampa texas* new species. Parapenis.
Fig. 12.—*Hoplocampa idaho* new species. Parapenis.
Fig. 13.—*Hoplocampa stricklandi* new species. Parapenis.
Fig. 14.—*Hoplocampa marlatti* Rohwer. Parapenis.
Fig. 15.—*Hoplocampa oregonensis* (Ashmead). Apical sternite.
Fig. 16.—*Hoplocampa spala* new species. Apical sternite.
Fig. 17.—*Hoplocampa sialica* new species. Apical sternite.
Fig. 18.—*Hoplocampa idaho* new species. Apical sternite.
Fig. 19.—*Hoplocampa nalema* new species. Apical sternite.

Plate VII

Male penis valves of *Hoplocampa* (all lateral aspect except 20A which is the dorsal aspect).

Abbreviations Used: D—dorsal edge. V—ventral edge.

Fig. 20.—*Hoplocampa ritcheri* new species.
Fig. 21.—*Hoplocampa testudinea* (Klug).
Fig. 22.—*Hoplocampa oregonensis* (Ashmead).
Fig. 23.—*Hoplocampa texas* new species.
Fig. 24.—*Hoplocampa sialica* new species.
Fig. 25.—*Hoplocampa bioculata* Rohwer.
Fig. 26.—*Hoplocampa spala* new species.
Fig. 27.—*Hoplocampa oskina* new species.
Fig. 28.—*Hoplocampa neneti* new species.
Fig. 29.—*Hoplocampa halcyon* (Norton).
Fig. 30.—*Hoplocampa alpestris* Rohwer.
Fig. 31.—*Hoplocampa stricklandi* new species.
Fig. 32.—*Hoplocampa pallipes* MacGillivray.
Fig. 33.—*Hoplocampa nalema* new species.
Fig. 34.—*Hoplocampa idaho* new species.

Plate VIII

Parts of *Hoplocampa*

Abbreviations Used: vl—ventral lobe. sp—spurette.

Fig. 35.—*Hoplocampa lacteipennis* Rohwer. Anterior aspect of head.
Fig. 36.—*Hoplocampa oregonensis* (Ashmead). Anterior aspect of head.
Fig. 37.—*Hoplocampa nalema* new species. Anterior aspect of head.
Fig. 38.—*Hoplocampa lacteipennis* Rohwer. ♂ penis valve.
Fig. 39.—*Hoplocampa montanicola* Rohwer. ♂ penis valve; A, lateral aspect, B, posterior aspect.
Fig. 40.—*Hoplocampa marlatti* Rohwer. ♂ penis valve; A, lateral aspect, B, posterior aspect.
Fig. 41.—*Hoplocampa cookei* (Clarke). ♂ penis valve; A, lateral aspect, B, posterior aspect.
Fig. 42.—*Hoplocampa sialica* new species. A, saw; B, apex of lancet.
Fig. 43.—*Hoplocampa texas* new species. Apex of lancet.
Fig. 44.—*Hoplocampa makila* new species. Apex of lancet.
Fig. 45.—*Hoplocampa bioculata* Rohwer. Apex of lancet.
Fig. 46.—*Hoplocampa oskina* new species. A, lancet; B, details of ventral lobes.

Plate IX

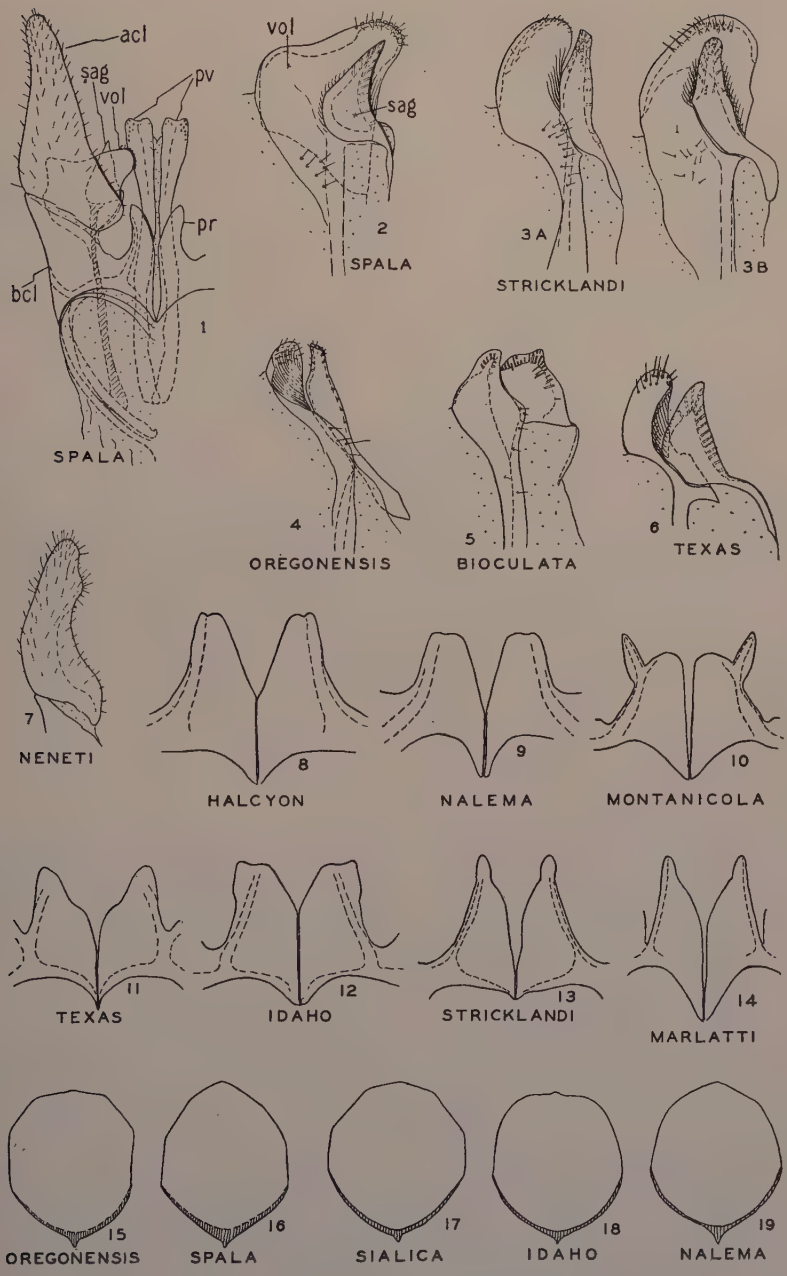
Abbreviations Used: at—apical teeth of ventral lobe. bt—basal tooth of ventral lobe. sp—spurette.

Fig. 47.—*Hoplocampa ritcheri* new species. A, saw; B, details of ventral lobes.
Fig. 48.—*Hoplocampa stricklandi* new species. A, saw; B, details of ventral lobes.
Fig. 49.—*Hoplocampa halcyon* (Norton). Apex of lancet.
Fig. 50.—*Hoplocampa alpestris* Rohwer. Apex of lancet.
Fig. 51.—*Hoplocampa pallipes* MacGillivray. Apex of lancet.
Fig. 52.—*Hoplocampa cookei* (Clarke). Lancet.
Fig. 53.—*Hoplocampa marlatti* Rohwer. A, lancet; B, apex of lancet.

Plate X

Abbreviations Used: as—alar spines. sp—spurette.

Fig. 54.—*Hoplocampa nalema* new species. A, saw; B, details of ventral lobes.
Fig. 55.—*Hoplocampa oregonensis* (Ashmead). A, lance; B, apex of lancet.
Fig. 56.—*Hoplocampa idaho* new species. A, lance; B, lancet.
Fig. 57.—*Hoplocampa lacteipennis* Rohwer. A, saw; B, apex of lancet.
Fig. 58.—*Hoplocampa montanicola* Rohwer. A, lancet; B, C and D, details of ventral lobes.
Fig. 59.—*Hoplocampa testudinea* (Klug). A, lancet; B, details of ventral lobes.



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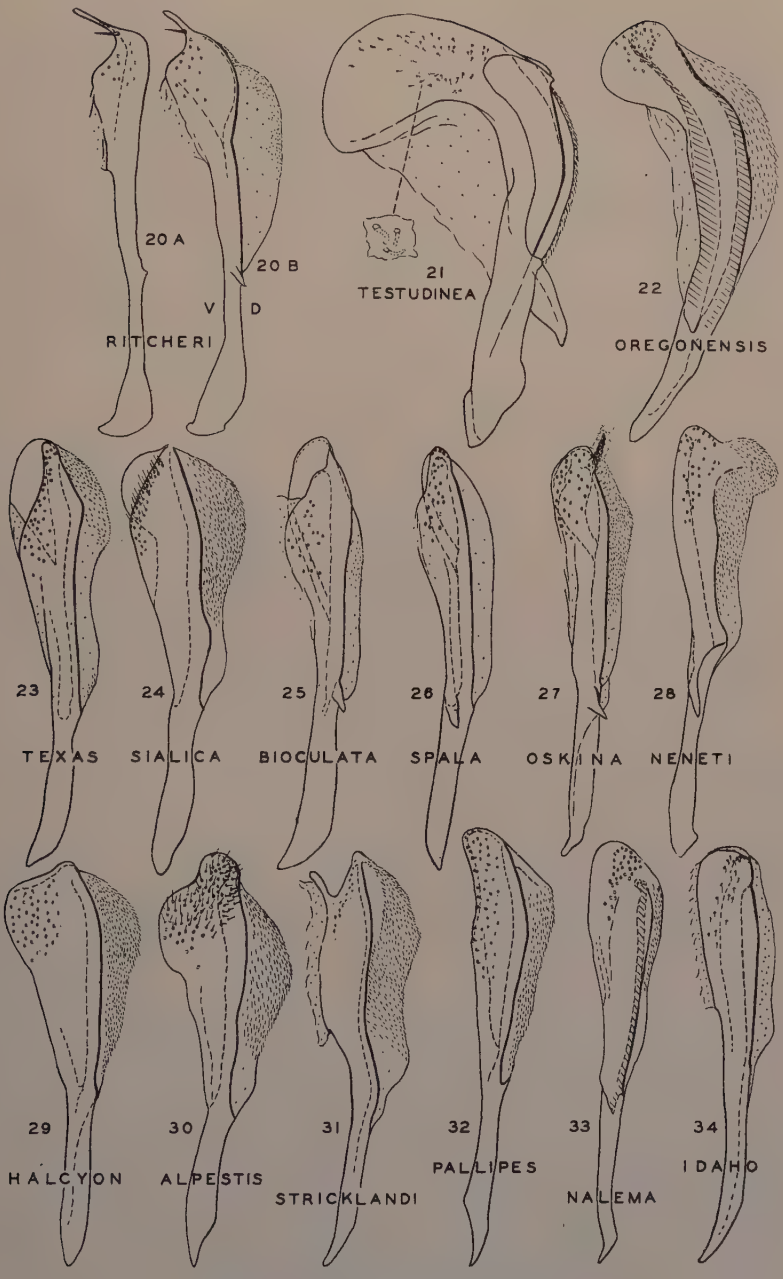

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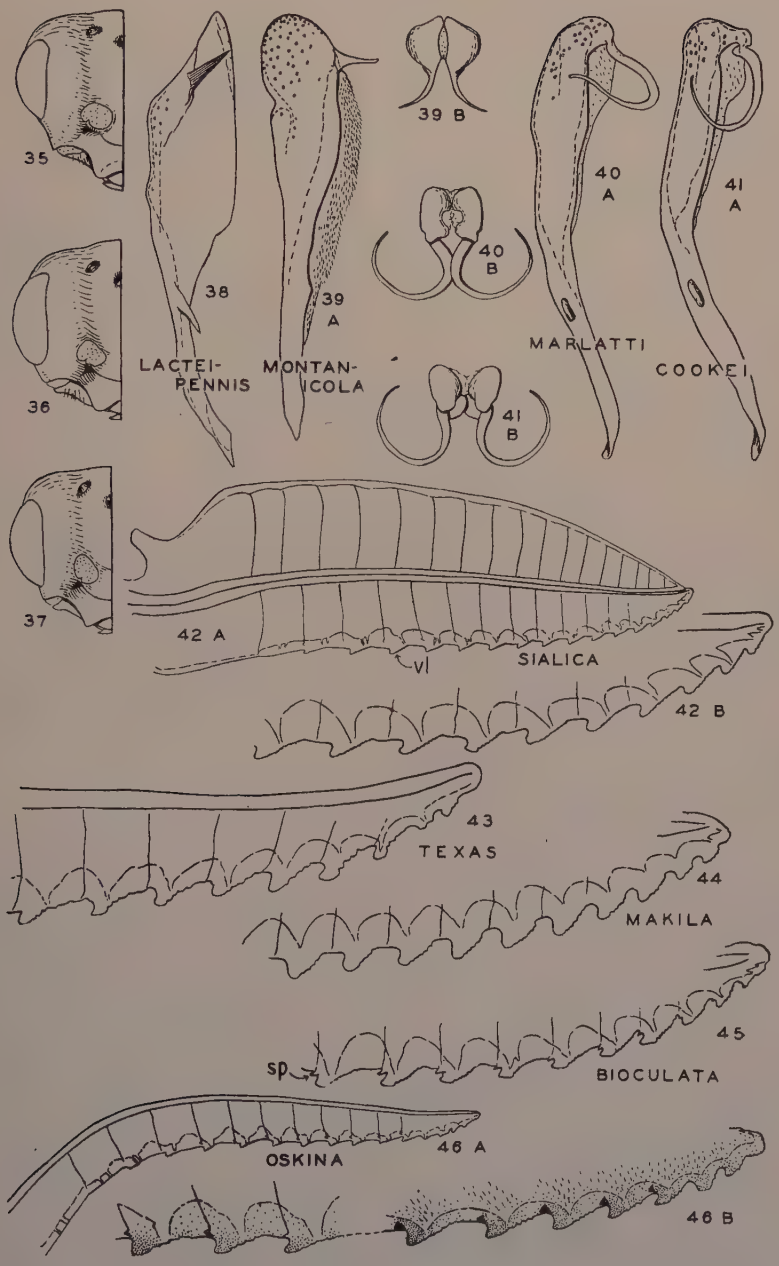

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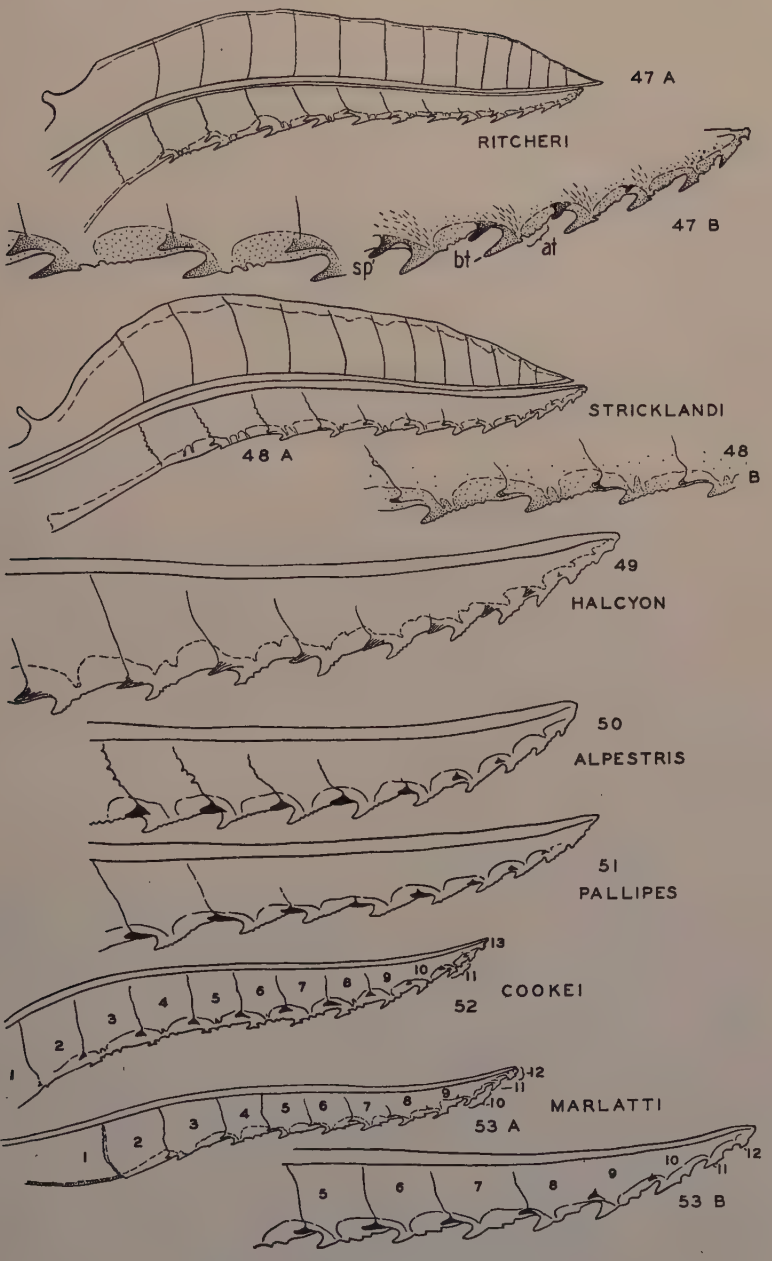

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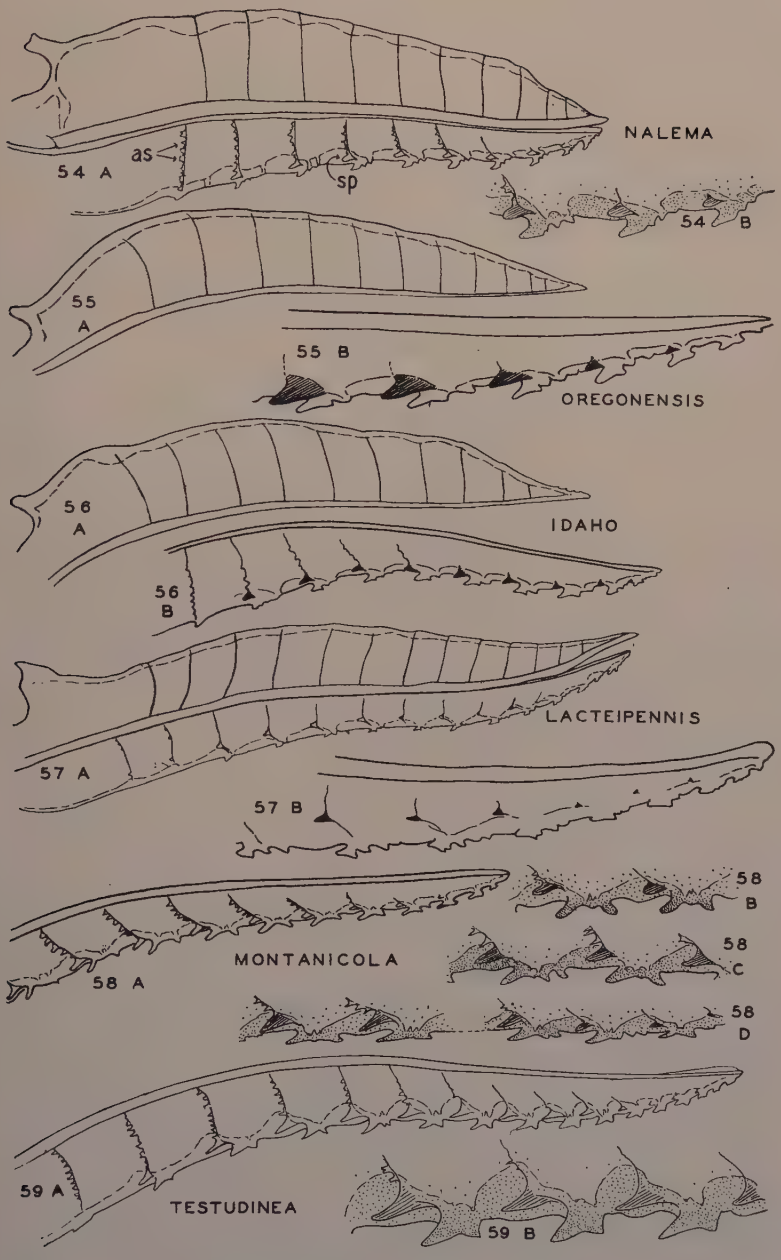

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REVISIONS OF THE GENERA TOWNSENDIELLA, TRIOPASITES AND PARANOMADA

(HYMENOPTERA: NOMADIDAE)[1]

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(Text-figures)

The genera considered in the present paper are among the smaller and least known groups of Nomadidae. Their distribution appears to center in southwestern United States. Little is known of their habits or bee hosts.

Genus TOWNSENDIELLA Crawford

1916. *Townsendiella* Crawford, Ins. Insc. Mens., IV, p. 138.
1936. *Townsendiella,* Michener, Ent. News, XLVII, p. 181.
1939. *Townsendiella,* Linsley and Michener, Trans. Amer. Ent. Soc., LXV, p. 279.

This genus is isolated phylogenetically but is probably related to *Neolarra* Ashmead. It differs markedly from the latter in the more complete wing venation, the form of the sixth abdominal sternite of the female, the presence of a pygidial area in the male, and the structure of the male genitalia. Three subgenera may be recognized as follows:

1. Maxillary palpi composed of six segments of unequal length; antennal flagellum more or less uniform in diameter.....2
Maxillary palpi composed of four segments, subequal in length, arising from a tubercle; antennal flagellum distinctly thickened beyond the middle; anterior wing about one and one-half times as long as thorax along mid-dorsal line; first submarginal cell nearly twice as long as second.....*Xeropasites*

[1] This is the fourth of a series of articles on North American Nomadidae. For the previous parts see Trans. Amer. Ent. Soc., LXV, pp. 265–305 and 345–362 (1939) and LXVI, pp. 307–318 (1941).

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2. Anterior wings elongate, more than one and one-half times as long as thorax along mid-dorsal line; marginal cell longer than distance from its apex to tip of wing; first submarginal cell but little longer than second; first recurrent vein usually received near base of second submarginal cell.....*Townsendiella* s.str.

Anterior wings short, less than one and one-half times as long as thorax along mid-dorsal line; marginal cell barely more than half as long as distance from its apex to tip of wing; first submarginal cell nearly twice as long as second; first recurrent vein usually received near apex of first submarginal cell.....*Eremopasites*

Subgenus **TOWNSENDIELLA** s.str.

This subgenus may be recognized by the long wings, elongate marginal cell, and relative proportions of the submarginal cells. Only a single species is known at present.

Head with lateral ocelli separated by more than ocell-ocular distance; antennae with flagellum more or less uniform in diameter; maxillary palpi half as long as antennal flagellum, composed of six segments of unequal length, first segment short, second segment longest, more than three times as long as first, third and fourth segments subequal in length, each but little shorter than second, fifth segment about half as long as fourth, sixth segment subequal to or barely shorter than fifth; labial palpi with first segment more than three times as long as second, third and fourth segments short, together about two-thirds as long as second segment. Wings elongate, anterior pair narrow, more than one and one-half times as long as thorax along mid-dorsal line; marginal cell elongate, longer than distance from its apex to tip of wing; first submarginal cell but little longer than second; first recurrent vein received by second submarginal cell, rarely interstitial with first transverse cubital vein.

TYPE: *Townsendiella pulchra* Crawford. (By monotypy.)

Townsendiella (Townsendiella) pulchra Crawford

1916. *Townsendiella pulchra* Crawford, Ins. Insc. Mens., IV, p. 138. ♀.

This species is characterized by the red abdomen, dark clypeus, pubescent anterior angles of the triangular area of propodeum. In his original description Crawford states that the claws of the female are flattened but this is apparently not the case.

Female. Color black, abdomen and mouthparts red, antennae, tegulae, and legs frequently partly reddish; pubescence short, scale-like, white and yellowish brown.

Head finely, closely punctate; pubescence of vertex and upper frons yellowish brown, dense but not entirely obscuring surface, that of lower face denser, white, obscuring surface; antennae frequently reddish beneath; inner

ocular margin nearly straight; clypeus dark with anterior margin reddish, surface clothed with dense white pubescence; labrum red, discal area closely punctate, thinly pubescent; mandibles darkened at apex.

Thorax black; pronotal collar and tubercles densely clothed with white pubescence; mesoscutum finely, closely punctate, densely clothed with yellowish brown pubescence which does not entirely obscure the surface, with a pair of longitudinal white lines running from anterior margin to posterior one-third, and a white marginal band; tegulae reddish; mesoscutellum with discal pubescence yellowish brown, marginal pubescence white; metanotum densely clothed with white pubescence; mesosternum and mesepisterna densely clothed with unbroken white pubescence which obscures the surface.

Propodeum black; dorsal surface densely clothed with white pubescence, except triangular area which is closely punctate with dense patches of white pubesence over the anterior angles.

Wings narrow, anterior pair nearly two and one-half times as long as apical width; membrane faintly dusky, veins brown, stigma dark brown; marginal cell nearly four times as long as greatest width; ratio of length of first submarginal cell to second, measured along posterior margin 11 : 9.

Legs reddish, posterior face of femora and outer face of tibiae densely clothed with white pubesence, femora dusky at base.

Abdomen red; tergites finely, closely punctate; first tergite largely clothed with dense white pubescence except for a transverse band in front of apical margin, tergites two to four with a dense band of white pubescence along apical margin which is broken at middle; sternites one to five clothed with dense white pubescence, thinner at base of sternites two and three and median line of sternite five.

Length, 5.5 to 6 mm.

Male. Color and pubescent pattern essentially as in female; pygidial plate longer than broad, sides gradually narrowing, apex evenly rounded.

Length, 5.5 to 6 mm.

Type locality.—Las Cruces, New Mexico.

Additional localities.—4 miles East of Edom, Riverside Co., California, (P. H. Timberlake and E. G. Linsley), 3 ♀, 1 ♂. Palm Springs, Riverside Co., California, (P. H. Timberlake), 1 ♀. Mazourka Canyon, Inyo Mts., Inyo Co., California, (C. D. Michener), 2 ♀, 1 ♂. 20 miles South of Pelacio, Lower California, (C. D. Michener), 1 ♀.

Flight period.—April and May.

Flower records.—*Dalea schottii* (P. H. Timberlake and E. G. Linsley), *Dithyraea wislizeni* (Crawford).

Host.—Unknown.

Subgenus **EREMOPASITES** Linsley

1942. *Eremopasites* Linsley, Pan-Pac. Ent., XVIII, p. 131.

This subgenus may be distinguished from *Townsendiella* s.str. by the short wings in which the marginal cell is scarcely more than half as long as the distance from its apex to the wing tip and the first submarginal cell is nearly twice as long as the second and usually receives the first recurrent vein near its apex.

Head with lateral ocelli separated by less than ocell-ocular distance; antennae with flagellum more or less uniform in diameter; maxillary palpi composed of six segments of unequal length, first segment shortest, second segment longest, more than twice as long as first, third and fourth segments subequal in length each a little longer than first, about half as long as second segment, fifth segment just perceptably longer than fourth, a little shorter than sixth which is two-thirds as long as second; labial palpi with first segment longest, second segment about two-thirds as long as first, third and fourth segments subequal in length, together nearly two-thirds as long as second segment. Wings short, anterior pair less than one and one-half times as long as thorax along mid-dorsal line; marginal cell short, much shorter than distance from its apex to tip of wing; first submarginal cell nearly twice as long as second; first recurrent vein received by first submarginal cell, rarely interstitial with first transverse cubitus.

TYPE: *Townsendiella californica* Michener. (By original designation.)

Townsendiella (Eremopasites) californica Michener (Text-figure 1.)

1936. *Townsendiella californica* Michener, Ent. News, XLVII, p. 181. ♀, ♂.
1939. *Townsendiella californica*, Linsley and Michener, Trans. Amer. Ent. Soc., LXV, p. 305, pls. 15 to 18. ♀, ♂.

Resembling *T.* (*T.*) *pulchra* Crawford but differing, in addition to the subgeneric characters, by the black rather than red abdomen, red clypeus, and the wholly bare triangular area of the propodeum.

Female. Color dark brown to black, clypeus, labrum and mandibles pale reddish or reddish brown, abdomen frequently reddish at sides of first two tergites; pubescence short, scale-like, white and yellowish brown.

Head finely, closely punctate; pubescence of upper frons and vertex, except for longitudinal white band through median ocellus, yellowish brown, dense but not entirely obscuring surface, that of lower face denser, white, obscuring surface; antennae brownish; inner ocular margin sinuate; clypeus reddish, finely, closely punctate, very sparsely pubescent; labrum reddish, finely punctate, sparsely pubescent; mandibles darkened at apex.

Thorax dark brown, pronotal tubercles and collar densely clothed with white pubescence; mesoscutum finely, closely punctate, densely clothed with

yellowish-brown pubescence which does not entirely obscure the surface, with a pair of median longitudinal white lines on each side of middle running from anterior margin nearly to middle and a narrow, marginal white band; tegulae brown, outer posterior margin bare, shining; mesoscutellum clothed with white pubescence except for a median longitudinal brownish band; metanotum densely clothed with white pubesence; mesosternum and mesepisterna densely clothed with unbroken white pubescence which obscures the surface.

Text-figure 1. *Townsendiella* (*Eremopasites*) *californica* Michener, ♀. (× 19.)

Propodeum brown, densely clothed with white pubescence except triangular area.

Wings broad, anterior wing barely more than twice as long as apical width; membrane dusky, especially broad apical margin, veins and stigma dark brown; marginal cell about two and one-half times as long as greatest width; ratio of length of first submarginal cell to second measured along posterior margin, 7.5 : 4.

Legs reddish; posterior face of femora and outer face of tibiae densely clothed with white pubescence.

Abdomen dark brown, tergites finely, closely punctate, first tergite clothed at sides and apical margin, except middle, with dense white pubescence, tergites two and three white pubescent at sides and with a white patch on apical margin on each side of middle, fourth tergite largely white pubescent with a thin spot at middle and one on each side of middle; sternites largely white pubescent.

Length, 4.5 to 5 mm.

Male. Generally similar to female but with clypeus and legs usually darker.

Type locality.—Altadena, California.

Specimens examined.—3 ♀, 2 ♂, paratypes.

Flight period.—June.

Host.—*Hesperapis rufipes* (Ashmead).

Subgenus **XEROPASITES** Linsley

1942. *Xeropasites* Linsley, Pan-Pac. Ent., XVIII, p. 130.

Xeropasites differs from both *Townsendiella* s.str. and *Eremopasites* by the four segmented maxillary palpi and thickened flagellum. The wings are shorter than in *Townsendiella* s.str. but less so than *Eremopasites.*

Head with lateral ocelli separated by less than ocell-ocular distance; antennae with flagellum distinctly thickened beyond middle; maxillary palpi less than half as long as antennal flagellum, composed of four segments subequal in length but becoming successively slightly shorter toward apex, basal segment inserted on a tubercle; labial palpi with first segment about twice as long as second, third and fourth segments short, subequal in length, together about two-thirds as long as second segment. Wings moderately elongate, anterior pair about one and one-half times as long as thorax along mid-dorsal line; marginal cell moderately elongate, about as long as distance from its apex to tip of wing; first submarginal cell nearly twice as long as second; first recurrent vein received by second submarginal cell.

TYPE: *Townsendiella* (*Xeropasites*) *rufiventris* Linsley. (By original designation,)

Townsendiella (Xeropasites) rufiventris Linsley

1942. *Townsendiella* (*Xeropasites*) *rufiventris* Linsley, Pan-Pac. Ent., XVIII, p. 130. ♀, ♂.

Female. Color black or dark piceus, abdomen red, tegulae, legs and mouth parts wholly or partially reddish; pubescence short, scale-like, white and yellowish brown.

Head finely, closely punctate; pubescence of upper frons and vertex yellowish brown, dense but not entirely obscuring surface, that of lower face denser, white, obscuring surface; inner ocular margins straight; antennae dark brownish; clypeus dark, anterior margin reddish, surface finely, closely punctate, pubescent; mandibles pale reddish, darker at apex.

Thorax piceus; pronotum and tubercles densely clothed with white pubescence; mesoscutum finely, closely punctate, clothed with yellowish brown hairs except a pair of white lines, frequently obliterated, on each side of middle and a narrow white marginal band; tegulae reddish; mesoscutellum, except disk, and metanotum densely white pubescent; mesosternum and mesepisterna densely clothed with unbroken white pubescence which obscures the surface.

Wings moderately narrow, anterior pair about two and one-fourth times as long as apical width; membrane slightly dusky, veins and stigma brown; marginal cell a little more than twice as long as greatest width; ratio of length of first submarginal cell to second, measured along posterior margin, 2 : 1.

Legs reddish or piceous, posterior face of femora and outer face of tibiae densely clothed with white pubescence.

Abdomen red; tergites finely, closely punctate, with a narrow band of dense white pubescence along apical margins and a patch of white pubescence at sides, sternites frequently brownish, more or less wholly white pubescent.

Length, 4 to 4.5 mm.

Male. Generally similar to female, legs and abdominal sternites frequently darker.

Length 4 to 4.5 mm.

Type locality.—Palm Springs, Riverside Co., California.

Additional localities.—Riverside, California, (P. H. Timberlake and E. G. Linsley), 3 ♀, 4 ♂.

Flight period.—March to April.

Host.—Unknown.

Genus **TRIOPASITES** Linsley

1939. *Triopasites* Linsley, Pan-Pac. Ent., xv, p. 8.
1939. *Triopasites,* Linsley and Michener, Trans. Amer. Ent. Soc., LXV, p. 293.

This genus is related to *Hesperonomada* Linsley and the two are separated from the other known Nomadini by the flattened antennal scape, short maxillary palpi of not more than five segments and by the form of the fifth abdominal sternite of the female. *Triopasites* differs from *Hesperonomada* by having three submarginal cells, the marginal cell rounded at the apex and separated slightly

from the wing margin, and by having only three segments in the maxillary palpi. The male genitalia are in some respects intermediate between *Hesperonomada* and *Paranomada,* the form of the coxopodites resembling the former, the sagittae and stipites suggesting the latter. The three known species may be distinguished as follows:

Key to the Species of Triopasites

Females

Thorax black, pleuron between wing bases and coxae at middle suffused with reddish; marginal cell moderately narrow at apex; punctures of mesoscutum and mesoscutellum dense; maxillary palpi three segmented. 5 mm. (Southern California).....*timberlakei*

Thorax red, mesoscutum piceous, disk clouded with red; marginal cell perceptibly more narrowed at apex; punctures of mesoscutum and mesoscutellum sparser; maxillary palpi four segmented. 4.5 mm. (Arizona).....*micheneri*

Males

Black, mouthparts, axillae, apices of femora, and tarsi piceous; clypeus finely but distinctly punctate; maxillary palpi four segmented. 4.5 mm. (Cape Region, Lower California).....*laguna*

Triopasites timberlakei Linsley

1939. *Triopasites timberlakei* Linsley, Pan-Pac. Ent., xv, p. 9. ♀.

Recognized by the dark thorax, only moderately narrowed marginal cell and dense punctures of the mesoscutum and mesoscutellum.

Female. Color black, mouthparts legs, and abdomen pale reddish, coxae at middle and pleura between wing bases suffused with reddish.

Head sparsely clothed with short, suberect, heavily plumose white hairs; antennae reddish piceous; vertex finely sparsely punctured; frons finely punctured about antennal bases, more coarsely, irregularly near margins of eyes; clypeus shining, finely sparsely punctate, surface sparsely clothed with short, fine pubescence; labrum more coarsely punctate than clypeus; mandibles becoming piceous toward apex; maxillary palpi three segmented, first segment globular, two and three elongate.

Thorax dominantly black; mesoscutum polished, subglabrous, more coarsely punctured than head, discal puncture largest, subcontiguous along median line, from one to three diameters apart at sides; tegulae testaceous, darker at middle; mesoscutellum subglabrous, punctured similarly to mesoscutum; metanotum densely clothed with long, heavily plumose white hairs; propodeum with sides coarsely punctured, clothed with long, white, plumose

hairs, triangular area subglabrous, dull, tessellate; mesosternum shining, coarsely, sparsely punctate; mesepisterna moderately coarsely, closely punctate, sparsely clothed with depressed pale hairs; anterior coxae clothed beneath with long, white, plumose hairs.

Wings with marginal cell moderately narrowed at apex. Legs moderately clothed with long pale hairs.

Abdomen dullish, tergites finely punctured at base, apical margin of first four tergites depressed, almost impunctate; tergites one to four sparsely clothed with very short, fine, inconspicuous, pale hairs, lateral apical margins with a transverse patch of long, white, plumose hairs; sternites two to four strongly depressed at apex, second sternite densely, third sternite sparsely, clothed with plumose white hair at middle.

Length, 5 mm.

Type locality.—Riverside, California.

Flight period.—May.

Triopasites micheneri new species (Text-figure 2.)

Distinguished from *timberlakei* by the dominantly red thorax, more apically narrowed marginal cell, and sparser punctation, especially of the mesoscutum and mesoscutellum, and the four-segmented maxillary palpi.

Text-figure 2. *Triopasites micheneri* Linsley, ♀. (× 14).

Female. Color reddish, face, vertex, mesoscutum, tibiae, and apex of femora dominantly or clouded with piceous; integument shining, finely punctate.

Head darkened above; antennae dark brown, first flagellar segment pale; vertex finely punctate; frons densely clothed with plumose white hairs, becoming sparser on vertex; clypeus shining, red, very finely, sparsely punctate, sparsely clothed with fine, short hairs; mouthparts reddish, mandibles margined and tipped with piceous; maxillary palpi four segmented, segments one and four subequal, two and three each a little shorter, subequal.

Thorax dominantly reddish; mesoscutum piceous, disk clouded with reddish, integument shining, subglabrous, thinly pubescent, punctures larger than on head; tegulae testaceous, darker at middle; mesoscutellum reddish, more finely punctured posteriorly than mesoscutum, thinly pubescent; metanotum reddish, densely clothed with plumose white hairs; propodeum densely clothed at sides with long, white, plumose hairs, triangular area subglabrous, clouded with piceous; mesosternum polished, coarsely, sparsely punctate, thinly clothed with long, white, plumose hairs; outer face of posterior coxae densely white pubescent.

Legs shining, tibiae clothed with long, white hairs.

Abdomen red, apex obscurely clouded at sides with piceous; tergites shining, finely punctured at base, first four tergites with apical margin depressed, almost impunctate, first tergite clothed over basal half with plumose white hairs, tergites two to four sparsely clothed with fine short, inconspicuous pale hairs, lateral apical margins with a transverse patch of long, plumose, white hair; fifth tergite finely, closely punctured at base; sternites two to four strongly depressed at apex, second sternite densely, third sternite sparsely, clothed with long recurved, plumose white hair at middle.

Length, 4.5 mm.

Holotype.—Female; 10 miles south of Tucson, Arizona; August 7, 1940 (C. D. Michener at flowers of *Verbesina* sp.); [California Academy of Sciences, Ent., no. 5274].

Triopasites laguna new species

Closely related to *micheneri* but differing in the black coloration, more numerous and distinct clypeal punctures, less abundant plumose pubescence of the face, and slightly different arrangement of the abdominal pubescence.

Male. Length 4.5 mm. Color black, mouthparts, axillae, apices of femora, and tarsi piceous or rufo-piceous; integument shining, finely punctate.

Head finely punctate; antennae black; frons thinly clothed with plumose white hairs, those of vertex scattered, sparse; clypeus finely but distinctly punctate; maxillary palpi four segmented.

Thorax, except tegulae, black; mesoscutum shining, thinly pubescent; mesoscutellum thinly pubescent; metanotum densely clothed with plumose white hairs; propodeum with triangular area subglabrous, sides densely clothed with long, white plumose hairs; posterior coxae with outer face densely white pubescent.

Abdomen with tergites one to six broadly depressed at apex, depression polished, almost impunctate, basal depression of first tergite clothed with plumose white hairs; lateral apical margins of tergites one to four with a transverse patch of plumose white hairs; second sternite densely clothed at middle with long, recurved, plumose white hairs, those of third sternite shorter; pygidial plate of seventh tergite rather broad, produced, broadly rounded or subtruncate at apex; genital armature moderately elongate, coxopodites with a small, inner, apical process, inner dorsal margins scarcely emarginate, stipites broad, moderately elongate, clothed apically with simple hairs, sagittae moderately broad, not attaining apex of stipites.

Length, 4.5 mm.

Holotype.—Male; La Laguna, Sierra Laguna, Lower California; October, 1941 (E. S. Ross and G. E. Bohart); [California Academy of Sciences, Ent., no. 5275].

Paratypes.—Three males, canyon beyond Las Animas Rancho, Sierra Laguna, Lower California; October, 1941 (E. S. Ross and G. E. Bohart) [One each in collections of Academy of Natural Sciences of Philadelphia, E. G. Linsley, and E. S. Ross and G. E. Bohart].

This may prove to be the male of either *T. micheneri* or *T. timberlakei.* It is more suggestive of the former but the differences enumerated above and the discontinuity in distribution have made it seem desirable to regard it as a distinct species for the present.

Genus **PARANOMADA** Linsley and Michener

1937. *Paranomada* Linsley and Michener, Pan-Pac. Ent., XIII, p. 82.
1939. *Paranomada,* Linsley, Pan-Pac. Ent., XV, p. 11.
1939. *Paranomada,* Linsley and Michener, Trans. Amer. Ent. Soc., LXV, p. 289.

Paranomada differs at once from all other North American nomadiine genera by the indistinctly impressed frontal line, dorsoventrally compressed thorax, polished integument, structure of the metasternum, and the lamellate coxae of the female. The two known species differ as follows:

Females

Pale reddish brown, pubescent bands on abdominal tergites two to four white; wings clouded with pale brownish, veins and stigma light brown. Length 7.5 mm. (Arizona) ..... *nitida*

Black, pubescent bands on abdominal tergites two to four ochraceous, wings clouded with brown, veins and stigma dark brown. Length 8–11 mm. (Arizona and Lower California) ..... *velutina*

Paranomada nitida Linsley and Michener

1937. *Paranomada nitida* Linsley and Michener, Pan-Pac. Ent., XIII, p. 83. ♀.

This species is pale reddish brown with white abdominal bands and pale brownish wings with light brown veins and stigma.

Female. Color pale reddish brown, shining, integument almost impunctate; pubescence long, white.

Head shining; occiput thinly clothed with long, white hairs; upper frons and vertex subglabrous; antennal insertions with a rosette of long, suberect, plumose white hairs; antennae pale reddish brown, scape clothed with moderately long, pale hairs; clypeus subglabrous; labrum densely pubescent; mandibles reddish, margins and apex piceous; ocelli black.

Thorax pale reddish brown, shining; pronotal collar and tubercles white pubescent; mesoscutum subglabrous, disk suffused with piceous; pubescence confined to margins; mesoscutellum subglabrous; metanotum pubescent, more densely at sides; vertical face of mesepisterna densely clothed with appressed white hairs; mesosternum thinly clothed with white hairs; intermediate and posterior coxae broadly lamellate.

Propodeum pale brown, with a dense patch of appressed, white, plumose hairs at side, over anterior angles of triangular area, and on each side of posterior angle of area.

Wings clouded with pale brown, anterior pair with a large pale area beyond submarginal and discoidal cells; veins and stigma pale brown.

Legs pale reddish brown; femora thinly clothed with white hairs; tibiae densely clothed externally with long, erect, white hairs.

Abdomen pale reddish, shining; first tergite subglabrous, tergites two, three, and four with a band of velvety white plumose pubescence along apical margin, that of second tergite thin (worn?) at middle; sternites thinly pubescent.

Length, 7.5 mm.

Type locality.—Phoenix, Arizona.

Flight period.—October.

Paranomada velutina Linsley (Text-figure 3.)

1939. *Paranomada velutina* Linsley, Pan-Pac. Ent., xv, p. 10. ♂.

Very similar to the preceding but a little larger and black, with ochraceous or golden abdominal bands and fuscous tinted wings with dark brownish veins and stigma.

Text-figure 3. *Paranomada velutina* Linsley, ♀. (×7).

Female. Color black, shining, integument almost impunctate; pubescence long, ochraceous.

Head shining; occiput thinly clothed with long, pale hairs; upper frons and vertex subglabrous; antennal insertions surrounded by a rosette of long, suberect, heavily plumose pale hairs; antennae black. Scape clothed with moderately long, pale hairs; clypeus subglabrous, rufo-piceous; labrum very densely clothed with moderately long, erect, pale hairs; mandible reddish at base becoming darker apically; maxillary palpi composed of four free segments, first segment longer than broad, second segment more than twice as long as third, third and fourth segments subequal or the fourth a little longer.

Thorax black shining; pronotal collar and tubercles densely clothed with pale hairs; mesoscutum subglabrous, pubescence confined to margins and a few scattered depressed hairs on disk; mesoscutellum subglabrous; metanotum pubescent, more densely at sides; vertical face of mesepisterna densely

clothed with appressed, pale hairs, mesosternum thinly clothed with pale hairs; intermediate and posterior coxae broadly lamellate.

Propodeum black, dorsal surface irregularly pubescent, with dense patches of appressed, white, plumose hairs on lateral margin, over anterior angles of triangular area, and on each side of posterior angle of area.

Wings tinted heavily with fuscous, anterior pair with a large pale area beyond submarginal and discoidal cells; veins and stigma dark brown.

Legs piceous; femora thinly clothed with pale hairs, tibiae densely clothed externally with long, erect, pale hairs.

Abdomen black, shining; first tergite subglabrous, tergites two three, and four with a dense, velvety band of heavily plumose, ochraceous or golden pubescence along apical margin; sternites thinly pubescent, with a few scattered irregular, coarse punctures at side and base and an impressed, impunctate margin along apex and extending forward irregularly at middle to about basal one-third.

Length, 8.5 to 11 mm.

Male. Form a little more slender than female; intermediate and posterior coxae not strongly lamellate externally; abdomen with pubescent bands on tergites two to six, pubescent bands more dense, more abruptly defined, basal half of tergites more sparsely clothed with suberect, pale plumose hairs; genitalia moderately elongate, coxopodites dorsally convex, stipites moderately elongate, clothed with simple hairs at apex; sagittae robust, nearly straight, with a few short hairs externally.

Length, 8.5 to 10.5 mm.

Type locality.—Douglas, Arizona.

Additional localities.—Turner, Arizona (Timberlake). 10 miles east of Douglas, Arizona, (C. D. Michener, E. S. Ross). Tombstone, Arizona, (E. S. Ross). 10 miles west of Bisbee, Arizona, (E. S. Ross); Carr Canyon, Huachuca Mts., Arizona, (C. D. Michener); 10 miles south of Tucson, Arizona, (C. D. Michener, E. S. Ross). Near Las Animas Rancho, Sierra Laguna, elev. 3,000 ft., Lower California, (E. S. Ross and G. E. Bohart).

Flight period.—August–October.

Flower records.—*Eriogonum albertianum* (Timberlake, Michener); *Mirabilis* sp. (Michener); *Aplopappus spinosulus* (Timberlake).

R43

COLOR VARIATION AND DISTRIBUTION OF APOICA PALLIDA (OLIVIER), A NOCTURNAL NEOTROPICAL SOCIAL WASP

(HYMENOPTERA: VESPIDAE)

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The latest Monograph of *Apoica,* by R. du Buysson (1906) is an excellent and well illustrated study of the morphology and bionomics of these wasps. His treatment of the color variants is, however, inadequate, partly due to the failure of recognizing properly some of the earlier described forms. This vitiates to some extent the recorded localities, which are, moreover, too few for general zoögeographical purposes. Ducke's later work, particularly his two more comprehensive studies (1910 and 1918), correct and complement du Buysson's work. The very extensive material which I have studied in American collections made it possible to gain a better insight into the color variation as well as the distribution of the several recognizable forms.

I was able to study the collections of the Museum of Comparative Zoölogy, the U. S. National Museum, the American Museum of Natural History, the Department of Entomology of Cornell University, the Carnegie Museum, the Academy of Natural Sciences of Philadelphia, and the Field Museum of Natural History.

The original descriptions are reproduced for the convenience of South American entomologists to whom they are rarely accessible. They will, furthermore, enable the student to decide in how far my own interpretation or use of the earlier names are correct.

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APOICA Lepeletier

Apoica Lepeletier, 1836, Hist. Nat. Ins. Hym., I, p. 536. (For two species: *Apoica lineolata* Lepeletier, 1836, and *Apoica pallida* Lepeletier, 1836.) [Type by present designation: *Apoica lineolata* Lepeletier = typical *Vespa pallida* Olivier, 1791.]

Apoeca W. A. Schulz, 1912, Berlin. Ent. Zeitschr., LVII, p. 84. (Emendation of *Apoica.*) [Same genotype.]

Ashmead [1] designated *"Polistes virginea* Fabricius" as the type of *Apoica.* Unfortunately, this was not one of the names or forms included by Lepeletier and, moreover, is a species of *Synoeca,* according to Fabricius' types. E. Blanchard [2] did not designate a type, stating merely that the first species was *"Agelaia lineolata* Lepeletier."

As pointed out by Ducke (1910, p. 515), *Apoica* is closely related to *Stelopolybia,* the main difference being the very large ocelli on the narrow vertex. The size of the ocelli is correlated with the decidedly nocturnal habits, the adults being often attracted by light. The characteristic nests are well described and figured by H. de Saussure, R. von Ihering, R. du Buysson, A. Ducke, W. A. Schulz, and others. Sometimes the nests are associated with those of the bird *Casicus persicus.*[3] *Apoica* is a polygynous wasp, new colonies being started by swarms leaving old nests and consisting of many females and a few males. Swarming occurs during the daytime. There is no appreciable difference in structure or size among the females, so that no queens or workers can be recognized.[4]

The genus contains only one structural species and is strictly Neotropical.

Apoica cubitalis H. de Saussure (1854, p. 109, pl. 18, fig. 3) is not a member of this genus, but a synonym of *Polybia sericea* (Olivier).

Apoica pallida (Olivier)

A study of some 4000 specimens from the entire range of the species allows me to recognize consistently five color forms. Some of these are better defined than others; but it is surprising how few specimens are really transitional, even though each form varies within certain (sometimes wide) limits. These remarks apply to the females, on which the subjoined key is based. The males are

[1] Canad. Entom., XXXIV, p. 166, 1902.
[2] Hist. Nat. Ins., III, Orth. Névr. Hém., Hym., Lép., Dipt., p. 396, 1840.
[3] W. A. Schulz, Hymenopteren-Studien, p. 123, 1905.
[4] Ducke, Bol. Mus. Goeldi, IV, pt. 4, p. 686, 1906.

rare in collections and the few I have studied sometimes depart markedly from the female pattern of the color form to which they belong.

1. Abdomen (except base of tergite 1) dorsally pale yellow or nearly white, often with silvery pubescence ("frosty"); venter either yellow or pale yellow or fulvous. Head and thorax pale fulvous or testaceous, usually spotted with yellow. Wings subhyaline, brownish-russet along the costa.....var. *pallens*

   Dorsum of abdomen not mostly pale yellow or white, never silvery or "frosty".....2

2. All abdominal tergites with a pale yellow, narrow or wide, apical margin; sixth tergite entirely yellow. Head and thorax spotted with yellow (mesonotum often with two or four yellow stripes). Wings subhyaline, slightly pale russet along the costa.....var. *arborea*

   Abdominal tergites not all margined with pale yellow.....3

3. Abdomen pale fulvous (except blackish first tergite), with apex of first tergite and a cross-band or two spots on base of second tergite pale yellow. Head and thorax blackish, without yellow spots (no stripes on mesonotum). Wings strongly infuscated, nearly violaceous-black. var. *albimacula*

   Second abdominal tergite uniformly pale fulvous to darker brown, the base never spotted nor banded with yellow.....4

4. Body pale fulvous to darker brown, either uniformly so or with abdomen paler than head and thorax. No or very few pale yellow markings, the mesonotum never striped and the head not marked with pale yellow. Wings more or less infuscated, sometimes markedly so...var. *thoracica*

   Body pale fulvous to darker brown, either uniformly so or with abdomen paler than head and thorax. Head and thorax usually with many pale yellow spots, the mesonotum with at least traces of longitudinal stripes. Apex of first tergite often yellow; sixth tergite as a rule mostly yellow. Wings slightly russet, darker along costa.....typical *pallida*

Distribution.—A. pallida occurs throughout tropical continental America. It is common in Trinidad, but, in the Antilles proper, it has been taken only in Grenada.[5] Northward it extends into southern Mexico (Tabasco; Vera Cruz). Southward it reaches the State of Santa Catharina in Brazil (Blumenau; Theresopolis) and Paraguay. There appears to be no reliable record from Argentina, although it might be expected in Misiones. The locality "Buenos Aires," given by Lepeletier for his *A. lineolata,* was an obvious error, as pointed out by Brèthes.[6]

[5] The locality St. Thomas, listed by R. du Buysson (1906, p. 341), was due to erroneous labeling of specimens, as Ducke (1910, p. 517) suggested.

[6] An. Mus. Nac. Buenos Aires, IX, p. 36, 1903.

Two or more of the color forms often occur in the same district or in the same locality, under what appear to be identical ecological conditions, but usually one form predominates. Their relative abundance and general range differ, however. In the collections studied, var. *pallens* and var. *arborea* are most abundant, each accounting for about 40 per cent of the specimens. Typical *pallida* and var. *thoracica* are about equally represented, each by less than 10 per cent. The balance is made up by the very few var., *albimacula*. The var. *pallens* is most widely distributed, being known from Mexico, British Honduras, Guatemala, the Republic of Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Trinidad, the island of Grenada, British Guiana, Dutch Guiana, French Guiana, Brazil, Paraguay, Bolivia, Peru and Ecuador. Next comes var. *thoracica,* reported from Guatemala, the Republic of Honduras, Costa Rica, Panama, Colombia, Venezuela, British Guiana, Dutch Guiana, French Guiana, Brazil, Bolivia, Peru and Ecuador. Typical *pallida* is definitely recorded from British Honduras, Colombia, Trinidad, British Guiana, Dutch Guiana, French Guiana, Brazil, Peru and Ecuador. The var. *arborea* has probably about the same distribution, with records from British Guiana, French Guiana, Dutch Guiana, Brazil, Peru, Bolivia and Ecuador. The var. *albimacula* is reported only from British Guiana and Dutch Guiana.

Apoica pallida (Olivier) typical form

Vespa pallida Olivier, 1791, Encyclop. Méthod., Insectes, VI, p. 675. [No sex, but probably ♀; Trinidad.]

Apoica lineolata Lepeletier, 1836, Hist. Nat. Ins. Hym., I, p. 537. [♀?; "Buenos Ayres."]

Polistes (or *Rhopalidia*) *translucida* Spinola, 1851, Mem. Ac. Sci. Torino, Sci. Fis. Mat., (2), XIII, p. 79. [♀; Pará.]

Apoica virginea H. de Saussure, 1854, Et. Fam. Vesp., II, p. 107, pl. 18, fig. 2. [♀; South America; described as n. sp., but with *Polistes virginea* "Fabricius" and *Apoica bilineolata* "Lepeletier" as synonyms.] Not *Polistes virginea* Fabricius, 1804.[7]

Apoica bilineolata "Lepeletier" H. de Saussure, 1854, Et. Fam. Vesp., II, p. 108. (As a synonym of *Apoica virginea.*) Error for *A. lineolata* Lepeletier, 1836.

Apoica lineata "Lepeletier" R. du Buysson, 1906, Ann. Soc. Ent. France, LXXV, p. 359. (As a synonym of *Apoica pallida.*) Error for *A. lineolata* Lepeletier, 1836.

[7] Fabricius' *Polistes virginea* was not a form of *Apoica pallida,* but a species of *Synoeca.*

Original descriptions:

V. pallida: "Vespa pallide rufa, thorace flavo maculato, abdominis petiolo utrinque puncto flavo. Elle a un peu plus de huit lignes de long [= 18 mm.]. Les antennes sont noirâtres avec l'extrémité roussâtre. La tête est d'un fauve pâle. Les mandibules sont terminées par trois dents noires. Le corcelet est fauve avec le dos obscur, un point de chaque côté, antérieurement, un sous l'origine des ailes, un autre à peine marqué, en arrière, trois sur l'écusson, dont deux à peine marqués, et deux autres en dessous, jaunes, avec le dos obscur, marqué de quatre petites lignes postérieures jaunes. Le pétiole est un peu alongé, d'un fauve pâle, avec un point jaune, de chaque côté de l'extrémité. L'abdomen est fauve pâle sans taches. Les pattes sont de la couleur du corps."

A. lineolata: "Tête ferrugineuse; base des mandibules pâle, (peut-être jaune dans l'Insecte vivant), l'autre portion garnie d'un duvet court d'un blanc argentin: orbite postérieure des yeux bordée d'une ligne pâle qui se continue derrière les ocelles. Antennes d'un brun ferrugineux à leur base; leur bout d'un jaune pâle; les articles intermédiaires noirâtres, surtout en dessus. Corselet d'un brun ferrugineux: une tache aux épaulettes, une autre sur les ailes, une double ligne courte sur la partie inférieure du dos, écusson, post-écusson et deux grandes taches sur le métathorax, de couleur pâle. Abdomen ferrugineux, dos du premier segment, vers le bord postérieur, de couleur pâle. Pattes ferrugineuses. Ailes transparentes; première cellule brachiale seule entièrement d'un brun ferrugineux. *Ouvrière?* Long. 13 lig. [= 29 mm.]."

P. translucida: "Femelle unique. Taille un peu plus grande. Couleur générale, testacée. Tête et dos du corcelet jaunes; une tache sur le vertex contenant le triangle ocellaire, trois rayes longitudinales droites et parallèles sur le disque du mésothorax, ligne médiane de l'écusson et du métathorax, brunes ou noirâtres. Premier anneau de l'abdomen comme dans la *pallens,* les cinq suivants réunis en ovale plus court et plus arrondi."

Olivier's original description mentions that the abdomen is unicolorous, pale fulvous, except for yellow side dots at the apex of tergite 1, the thorax fulvous, darker dorsally, with many yellow markings (4 small yellow lines on the mesonotum posteriorly). Lepeletier's *lineolata* had a similar pattern, but he describes the ground color as ferruginous-brown and mentions only two short paler lines on the mesonotum. Spinola's brief account of *P. translucida* agrees best with the paler ("testaceous") specimens of typical *A. pallida,* as he calls the extensive markings of the thorax "yellow" by contrast (mesonotum yellow with three brown stripes). H. de Saussure's *A. virginea* is readily recognized as typical *pallida* from the figure and his first description (p. 108); but later,

in the same work (p. 244), he referred to *virginea* a variant which was clearly of the var. *albimacula.*

The ground color varies from testaceous-brown to fuscous or pale mahogany. In the female, the often extensive paler markings of head, thorax, apex of tergite 1 and tergite 6, are ivory-white to pale yellow. The posterior orbits are frequently, though not always, yellowish; the four yellow stripes of the mesonotum are usually narrow and short, sometimes very weak or faded. As a rule, the wings are paler than in var. *thoracica.*

The few males seen are more extensively yellow on head and thorax than the females, the clypeus, entire posterior orbits and vertex (behind the ocelli) being of that color. The thorax is more yellow than fuscous, the four stripes of the mesonotum being very broad, although the median ones do not reach the scutellum and begin far behind the pronotum.

This is a moderately large form of the species, the fore wing being 15.5 to 18 mm. (usually 17 mm.) long.

Distribution.—BRITISH HONDURAS: Benque Viejo. COLOMBIA: Buenaventura. TRINIDAD: Port-of-Spain; Maracas Valley; Coparo; St. Augustine; Mayaro Bay. BRITISH GUIANA: Mackenzie, Demerara River; Shudihar River; Wismar; Torani Ranch, Berbice River; Rockstone, Essequibo River; Upper Rupununi River; Bartica; Kartabo; Kamukusa; Arakaka; Penal Settlement, Mazaruni River; Tumatumari, Potaro River; Georgetown. DUTCH GUIANA: Paramaribo; Koffiekam, Surinam River; Sint Barbara Plant., Surinam River; Ongelijk, Para River; Kwakoegron, Saramacca River; Zanderij Id., Upper Para District; Moengo, Upper Cottica River. FRENCH GUIANA: St. Jean du Maroni; Cayenne. BRAZIL: below Codajos, Rio Solimões; Rio Tajapurú, Amazonas; Furo de Ressaco, Amazon River; Porto America, Rio Putumayo; below Rio Negro on Amazon River; between Gurupa and Santarem, Amazon River; Mt. Roraima; Limão, Rio Surumu. PERU: Yurimaguas; Rio Santiago. ECUADOR: Puyo, Oriente.

R. du Buysson's "typical *A. pallida*" (1906, p. 341) appears to have been a mixture, so that his locality records cannot be used.

Apoica pallida var. **thoracica** R. du Buysson

Apoica pallida var. *thoracica* R. du Buysson, 1906, Ann. Soc. Ent. France, LXXV, pp. 340 and 343, pl. 11, fig. 7. [♀; Camopi, French Guiana; and Espirito Santo, Brazil.]

Original description:

"*Femelle.*—Noir, avec l'abdomen testacé; le pétiole de l'abdomen noir avec l'extrémité testacée. Pubescence grisâtre sur les parties noires, rousse sur les parties testacées. L'extrémité du dernier article antennaire est roussâtre.

Parfois le dessous du thorax peut devenir légèrement roussâtre, ainsi que les tarses. Les écailles sont noirâtres avec une petite tache pâle à l'extrémité. Les ailes sont uniformément enfumées, à teinte noire.—Long. 23–24 mill."

Although du Buysson's description was based on wasps in which the "testaceous" abdomen contrasted with the "black" head, thorax and tergite 1, I use his name to cover all females without or with scarcely any yellowish or whitish markings. All gradations occur between specimens colored as described by du Buysson and others which are uniformly mahogany or even blackish-brown. If pale markings are at all present, they are restricted to one or more of the following areas: hind margin of pronotum (usually very faint); a spot in upper plate of mesepisternum (below the wing); a blotch on the tegula; a spot on the postscutellum; the narrow hind margin of the scutellum; and a very narrow apical streak on tergite 1. I have seen no specimen having all these markings at once. The head is unspotted and tergite 6 (♀) is very rarely marked with yellow. The wings are usually darker than in typical *pallida,* often uniformly smoky or blackish; but all gradations occur to the paler wings of typical *pallida.* It is one of the larger forms of the species, the fore wing reaching 17 to 20 mm. in length.

The males are usually more extensively yellow on the thorax, although without mesonotal stripes. Even the propodeum may be partly or mostly yellowish and the posterior orbits also are more or less yellowish.

Distribution.—The var. *thoracica* is probably as widely distributed as typical *pallida.* GUATEMALA: Cayuga; Chejel. REPUBLIC OF HONDURAS: Choloma. COSTA RICA: San José; Guapiles; Hamburg Farm; Colima; La Fuente; Barranca. PANAMA: Trinidad River; Barro Colorado Id. COLOMBIA: Hacienda Yacuana near Villavicencio, Int. Meta; Restrepo, Int. Meta. VENEZUELA: Mt. Duida; Barinas; Rio Chacarito, Estado Miranda; Cumaragua. BRITISH GUIANA: source of Essequibo River; Tumatumari, Potaro River; Mackenzie, Demerara River; Shudihar River; Cuyuwini River; Kartabo; Bartica. DUTCH GUIANA: Kwakoegron, Saramacca River; Zanderij Id., Upper Para District. BRAZIL: Manaos; Vista Alegre (Rio Branco), Amazonas; Lower Rio Negro, Amazonas; Carmo (Rio Branco); Carvoeiro (Rio Negro), Amazonas; Pará; Cucuhy, Rio Negro; Porto Velho, Rio Madeira; Santarem; mouth of Rio Teffe in Rio Solimões; Rio Içа, Putumayo; Porto America, Putumayo; Furo de Ressaco, Amazon River; below Codajos, Rio Solimões; Boâ Vista de Jaquiri, Rio Teffe; Rio Tapajuri; Itacoatiara, Amazon River; Faz. Poço Grande (Juquiá), Estado S. Paulo. BOLIVIA: Prov. Sara; Rio Colorado; Ivon, Rio Beni; Rio Negro;

Blancaflor, Rio Beni; Cavinas, Río Beni. PERU: Rio Igara Parana, Oriente; El Porvenir, Cam. del Pichis; La Chorrera, Putumayo; Oxapampa; Rio Ucayali; Lower Rio Napo; Iquitos; Lower Rio Tapiche; Rio Santiago; Archinamiza. ECUADOR: Salidero, in the northwestern part.—R. du Buysson described it from French Guiana.

Apoica pallida var. **pallens** (Fabricius)

Polistes pallens Fabricius, 1804, Syst. Piezat., p. 276. [No sex; South America.]

Apoica pallida Lepeletier, 1836, Hist. Nat. Ins. Hym., I, p. 538. [♀?; Cayenne; described as a n. sp., without reference to Olivier's *Vespa pallida*.]

Original descriptions:

P. pallens: "P. pallida, capite, thoracis dorso alarumque costa obscurioribus. Media. Caput obscurum, clypeo cinereo pubescente. Thorax pallide flavescens dorso obscuriore. Abdomen pallens petiolo campanulato brevi. Alae pallidae costa usque ad medium late obscuriore."

A. pallida: "Tête ferrugineuse; base des mandibules et orbite postérieure des yeux pâles; cette couleur se continuant derrière les ocelles. Antennes d'un brun ferrugineux à leur base; leur bout d'un jaune pâle; les articles intermédiaires noirâtres, surtout en dessus. Corselet ferrugineux; bord des épaulettes, une tache sous les ailes, écusson, post-écusson et une tache double sur le métathorax, de couleur pâle. Abdomen pâle; base du premier segment, c'est-à-dire le pédicule, ferrugineux. Pattes ferrugineuses. Ailes transparentes; première cellule brachiale seule entièrement d'un brun ferrugineux. *Ouvrière?* Long. 13½ lig. [= 30 mm.]. Serait-ce une simple variété de la première espèce? [= *A. lineolata* Lep.]."

W. A. Schulz [8] recognized *Apoica* in Fabricius' types of *pallens* at Copenhagen. Both R. du Buysson (1906) and Ducke (1910) used the name for the same form as I do. R. du Buysson (1906, p. 342) also recognized that Lepeletier's (1836) and H. de Saussure's (1854, p. 107, pl. 18, fig. 1) *Apoica pallida* were not the typical form (as described by Olivier), but var. *pallens*. Moreover, Lepeletier described his *A. pallida* as a new species. Unfortunately, R. du Buysson included among the synonyms of *pallens* Fabricius, *Rhopalidia pallens* Lepeletier.[9] This, described as a new species without a reference to Fabricius' *Polistes pallens,* was a species of *Stelopolybia,* recognized by Ducke as identical with *Polybia infernalis* H. de Saussure.

The very pale abdomen is characteristic of this form, which has also many pale markings on head and thorax, including usually

[8] Berlin. Ent. Zeitschr., LVII, p. 84, 1912.
[9] Hist. Nat. Ins. Hym., I, p. 539, 1836.

stripes on the mesonotum. Even in the female, head and thorax are often more yellow than fuscous. As a rule, the median mesonotal stripes are fused into a broad prescutellar patch. The yellow of the abdomen is sometimes bright and rather dull; more often it is very pale, ivory-white and densely covered with short silvery hairs, giving it a "frosty" or "hoary" appearance. After death the yellow may become blotched with fuscous. In some specimens the sternites are fuscous; in others they are colored like the tergites. It is a large form, with the fore wing 16.5 to 18 mm. long.

Some of the few males seen are colored like the females. Others are less extensively yellow, sometimes with mere traces of mesonotal yellow stripes or with extensive fuscous blotches on the abdominal tergites.

Distribution.—The var. *pallens* is the most common and most widely distributed form. MEXICO: Cordoba, Vera Cruz; Frontero, Tabasco. BRITISH HONDURAS: Belize; Manatee. GUATEMALA: Cayuga; Mocá near Guatalon, 1,000 m.; Santa Emilia near Pochuta, 1,000 m.; La Providencia, Obispo; Trece Aguas; Palinque; Secanquin, Alta Vera Paz; Quirigua. REPUBLIC OF HONDURAS: Porto Arturo. NICARAGUA: Waunta River. COSTA RICA: Hamburg Farm; La Fuente. PANAMA: Potrerillos; Santa Rosa; Barro Colorado Id.; Cano Saddle, Gatun Lake; Cabima; Santiago, Verag.; El Cermeno; Trinidad River; Tabernilla; Alhajuelo; La Chorrera; Porto Bello; La Campana. COLOMBIA: Landazuri, Dept. Santander; Boca del Rosario, Dept. Santander; Santa Marta; Rio Frio, Dept. Magdalena; Cincinnati, San Lorenzo Mts., Dept. Magdalena; Banco, Dept. Magdalena; Calamar, Dept. Atlantico; Restrepo, Int. del Meta; Cauca Valley; Santander del Sur. VENEZUELA: Rio Cassiquiare; San Silvestre, Est. Barinas; Barinas; Est. Zulia; Iboa-Yaracuy; Cumaragua. TRINIDAD: Port-of-Spain; St. Augustine; heights of Aripo; Montserrat. ISLAND OF GRENADA, W. I. (specimen collected by Aug. Busck). BRITISH GUIANA: Kamakusa; Shudihar River; Oronoque River, 2° 42′; Kartabo; Kuyuwini River; Georgetown; source of Essequibo River; Tumatumari, Potaro River. DUTCH GUIANA: Moengo, Upper Cottica River; Kwakoegron, Saramacca River; Ongelijk, Para River. FRENCH GUIANA: Les Hattes; St. Laurent du Maroni. BRAZIL: Rio de Janeiro; Bahia; Parahyba; Bonito, Pernambuco; Viçosa, Minas Geraes; Pará; Manaos; Obidos; Baixa Verde, Rio Grande do Norte; Rio Iça-Putumayo; Lassance, Minas Geraes; Nictheroy, Est. Rio; Itatiaya, Est. Rio; Flores near Manaos; Arary to Manaos, Amazon River; Chapada, Matto Grosso; Anapolis, Goyaz; Maracajú, Matto Grosso; Vista Alegre (Rio Branco), Est. Amazonas; Faz. Poço Grande (Juquiá), Est. S. Paulo. PARAGUAY: San Bernardino; Puerto Bertoni, Alto Parana; Sapucay; Mbovevo; Villarrica; Molinescue. BOLIVIA: Tumupasa; Prov.

Sara; Blancaflor, Rio Beni; Ivon, Rio Beni; Rio Colorado; Rio Negro; Cavinas, Rio Beni. PERU: Iquitos; Rio Tapiche; Callao; San Luis de Shuare, Rio Paucartambo, 1,000 m.; San Ramon, Valle Chanchamayo, 800 m.; La Chorrera, Putumayo; Puerto Bermudez, Rio Pichis; El Campamiento, Col. Perene; middle Rio Ucayali; Santa Ana near Cuzco, 1,200 m.; Yurimaguas. ECUADOR: Salidero, in the northwestern part.

A. pallida var. **arborea** H. de Saussure

Apoica arborea H. de Saussure, 1854, Et. Fam. Vesp., II, p. 108, pl. 26, fig. 1. [♀; South America.]

Original description:

"Ferruginea; antennis obscuris, apice ferrugineis; prothorace supra scutellisque, flavis; mesothorace nigro; abdomine fasciis flavis. Long. 11 mill.; env. 28 mill.; long. tot. 16 mill. *Fem.* Corselet arrondi en avant, moins large que la tête; post-écusson saillant, mais sans crête. Pétiole plus grêle à sa base, et plus élargi en arrière que dans les autres espèces. Insecte lisse; le métathorax et l'abdomen luisants. Tête ferrugineuse: mandibules et chaperon de cette couleur; vertex et front noirs; espace derrière les yeux jaune; antennes brunes, moins obscures en dessous; leurs six derniers articles ferrugineux. Corselet ferrugineux, prothorax jaune en dessus; disque du mésothorax noir; une tache sous l'aile et écussons, jaunes. Abdomen ferrugineux, brunâtre du côté dorsal: tous les segments bordés de jaune; anus jaune. Pattes ferrugineuses. Ailes transparentes, à peine enfumées, la côté jusqu'au point assez ferrugineuse; deuxième cubitale en trapèze; la troisième presque carrée; la quatrième de même grandeur que la troisième."

It is strange that R. du Buysson did not recognize this form in de Saussure's figure and claimed (1906, p. 333) that it was not an *Apoica;* but Ducke (1910, p. 517) saw the type at the British Museum and placed it correctly. R. du Buysson apparently included some *arborea* among his records of var. *virginea.*

The characteristic pale yellow apical margins of the tergites vary in width, being sometimes very narrow or even absent on some segments. Head and thorax are always well provided with yellowish markings, the longitudinal stripes of the mesonotum rarely wanting. Occasionally specimens are transitional to var. *pallens.* Tergite 6 of the female is almost always entirely yellow. It is the smallest form of the species, the fore wing measuring 14 to 16 mm. (usually 15 mm.).

One male, from Paramaribo, agrees with the females in color pattern; tergite 7 is entirely yellow.

Distribution.—The var. *arborea* is mainly a form of the northern half of South America. BRITISH GUIANA: Tumatumari, Potaro River, Kartabo; Torani Ranch, Berbice River; Shudihar River; Mazaruni River. DUTCH GUIANA: Paramaribo. FRENCH GUIANA: Nouveau-Chantier. BRAZIL: Pará; Obidos; Madeira-Mamore Railroad (Camp 28); mouth of Rio Jutahy (Rio Solimões). BOLIVIA: Prov. Sara; Santa Cruz. PERU: San Ramon, Valle Chanchamayo, 800 m.; La Chorrera, Putumayo; Puerto Bermudez, Rio Pichis; El Campamiento, Col. Perene; Napo River; Iquitos.—Zavattari[10] reported it from Ecuador (Cuenca).

A. pallida var. **albimacula** (Fabricius)

Polistes albimacula Fabricius, 1804, Syst. Piezat., p. 277. [No sex; South America.]

Polistes albimaculata "Fabricius" H. de Saussure, 1854, Et. Fam. Vesp., II, pp. 212 and 247. [As an unrecognized *Polybia*.] Error for *Polistes albimacula*.

Original description:

"P. nigra, abdomine ferrugineo: segmento secundo basi late albo. Caput, thorax, antennae nigra, obscura, immaculata. Abdomen ferrugineum, petiolo sive primo segmento nigro, apice albo, secundo basi late albo, apice ferrugineo, reliquis ferrugineis immaculatis. Alae nigrae, apice albicantes. Pedes nigri."

W. A. Schulz[11] recognized Fabricius' types at Copenhagen as *Apoica*.

The blackish, unspotted or scarcely spotted head and thorax, the ferruginous or reddish-brown abdomen (except for the blackish tergite 1, which is often bone-yellow at the apex), the bone-yellow base of tergite 2, and the very dark, nearly black wings are characteristic. The extent of yellowish at the base of tergite 2 varies. The largest form of the species, with the wing 18 to 21 mm. long.

The three males, from Dutch Guiana, which I refer to var. *albimacula* have the basal yellow area of tergite 2 much reduced, usually to two lateral spots. The inner and outer orbits are mostly yellow; but the clypeus is fuscous.

The variant of *"A virginea"* described by de Saussure (1854, p. 244) was clearly var. *albimacula:*

"Fem. Tête et corselet bruns ou noirâtres; écailles et bord postérieur du prothorax ferrugineux. Pétiole brun; abdomen ferrugineux, très déprimé; bout du pétiole et les deux tiers antérieurs du deuxième segment, d'un jaune pâle."

[10] Boll. Mus. Zool. Anat. Comp. Torino, XXI, No. 529, p. 10, 1906.
[11] Berlin. Ent. Zeitschr., LVII, p. 84, 1912.

Distribution.—The var. *albimacula* is the rarest of the forms of the species. I know it from a few localities only. BRITISH GUIANA: Shudihar River; Kartabo; Pakaraimo Mts.; at the headwaters of the Mazaruni River. DUTCH GUIANA: Loë; Moengo, Upper Cottica River. I have seen a female labelled "Mexico," but I doubt that this locality is correct.

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A REVISION OF THE GENUS NEOPASITES

(HYMENOPTERA: NOMADIDAE)[1]

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(Text-figures)

The genus *Neopasites* is one of the smaller genera of North American Nomadidae. It is confined primarily to the area from the Rocky Mountains eastward to the Atlantic Coast, where it is parasitic in the nests of bees of the panurgid genus *Calliopsis*.

Genus **NEOPASITES** Ashmead

1898. *Neopasites* Ashmead, Psyche, VIII, p. 284.
1899. *Neopasites* Ashmead, Trans. Amer. Ent. Soc., XXVI, p. 81.
1899. *Holcopasites* Ashmead, Trans. Amer. Ent. Soc., XXVI, p. 82.
1903. *Holcopasites* Cockerell, Ann. Mag. Nat. Hist., (7), XII, p. 452.
1910. *Neopasites* Cockerell and Robbins, Univ. Colo. Studies, VII, p. 183.
1915. *Holcopasites* Crawford, Ins. Insc. Mens., III, p. 123.
1916. *Neopasites* Viereck, Conn. Geol. Nat. Hist. Surv., Bull. no. 22, p. 722.
1916. *Holcopasites* Crawford, Ins. Insc. Mens., IV, p. 136.
1926. *Holcopasites* Cockerell and Hicks, Entom. News, XXXVII, p. 108.
1933. *Holcopasites* Popov, Trav. Inst. Zool. Acad. Sci. U. R. S. S., II, p. 60.
1935. *Holcopasites* Grütte, Arch. f. Naturgesch., IV, p. 513.
1939. *Neopasites* Linsley and Michener, Trans. Amer. Ent. Soc., LXV, p. 275.
1942. *Neopasites* Linsley, Pan-Pac. Entom., XVIII, p. 127.

Neopasites occupies an isolated position in the Nearctic nomadid fauna. It may be readily recognized by the following combination of characters: body very coarsely punctate, antennae twelve-seg-

[1] This is the sixth of a series of articles on North American Nomadidae. For the previous parts see *Trans. Am. Ent. Soc.*, LXV, pp. 265–305 and 347–362, 1939; LXVI, pp. 307–318, 1941; LXIX, pp. 93–106, 1943.

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mented in both sexes, labrum elongate, fifth abdominal tergite of female longitudinally ridged. For a discussion of the relationships of the genus, see Linsley and Michener (1939).

Subgenera of Neopasites

1. Eyes densely clothed with short, erect pubescence.....2
   Eyes bare; anterior and lateral ocelli separated by less than twice their diameters; supra-antennal area closely, coarsely punctate.
   Neopasites str.
2. Sides of face at margin of clypeus with a broad tooth; anterior and lateral ocelli separated by less than twice their diameters; supra-antennal area closely, coarsely punctate.....*Odontopasites*
   Sides of face at margin of clypeus without a broad tooth; anterior and lateral ocelli separated by at least three times their diameters, ocelli small; supra-antennal area polished, impunctate.....*Trichopasites*

Subgenus **TRICHOPASITES** Linsley

1942. *Trichopasites* Linsley, Pan-Pac. Ent., XVIII, p. 127.

Form robust; integument coarsely punctate; eyes densely clothed with short erect pubescence; ocelli small, anterior and lateral ocelli separated by at least three times their diameters; supra-antennal area polished, impunctate; sides of face at clypeal margin without a broad tooth.

TYPE: *Neopasites* (*Trichopasites*) *insoletus* Linsley.

This subgenus may be distinguished from both *Neopasites* s. str. and *Odontopasites* by the small, widely separated ocelli and smooth supra-antennal area. From the former subgenus it may be further separated by the pilose eyes. The following is the only known species.

Neopasites (Trichopasites) insoletus Linsley

1942. *Neopasites* (*Trichopasites*) *insoletus* Linsley, Pan-Pac. Ent., XVIII, p. 128. ♀.

Female. Color piceus, abdomen red; pubescence white, scale-like, forming patches on head, thorax, and abdominal tergites.

Head with a conspicuous white pubescent patch at base of antennae, extending laterally nearly to the eyes and partially encircling the antennal insertions; occiput with an indistinct patch behind the eyes; antennae with first segment of flagellum subequal in length to the following two together; vertex coarsely, subcontiguously punctured; pubescence of eyes brownish; sides of face and clypeus coarsely, subcontiguously punctured, sparsely clothed with a few short, suberect, pale hairs; labrum carinate, coarsely punctate; mandibles reddish, base piceus.

Thorax coarsely, closely punctate; mesoscutum with a thin patch of white pubescence along anterior half of median line and similar patches on each side, one just anterior to, the other to one side of, the tegulae; mesoscutellum with a subtriangular white pubescent patch on apical margin extending forward on median line for about one-third its length, lateral margin irregularly lined with white pubescence; vertical face of mesepisterna irregularly margined with white pubescence; mesosternum a little more shining and more irregularly, less closely punctured than scutum; propodeum coarsely punctured, triangular area glabrous, finely punctured and tesselate.

Wings pale brownish, first submarginal cell about twice as long as second, receiving first recurrent nervure just before apex (nearly interstitial with first transverse cubitus), second submarginal cell receiving its recurrent nervure at apical one-third.

Legs clothed with short, suberect, pale hairs, with a few irregular patches of white hairs on posterior faces of femora and tibiae.

Abdomen opaque, closely and rather coarsely punctured, indistinctly clothed with fine, pale hairs; first tergite with a white patch on each side of middle on basal margin and a pair of smaller patches at lateral apical margins, tergites two to four with an oval or subtriangular white spot on each side of middle at base and a similar patch on each side at lateral apical margin, these latter becoming smaller on successive segments, that of the fourth tergite only feebly indicated; fifth tergite with coarse longer golden hairs on each side of middle at base, apex densely fringed with fine, pale, erect hairs, sternites two to four with a narrow apical band of denser white pubescence, fifth sternite a little more densely pubescent than the preceding, apex slightly emarginate. Length, 5.5 mm.

Type locality.—Tex Canyon, Chiracahua Mts., Arizona.

Flight period.—September.

Only the type has been seen.

Subgenus **ODONTOPASITES** Linsley

1942. *Odontopasites* Linsley, Pan-Pac. Ent., XVIII, p. 128.

Form robust; integument coarsely punctate; eyes densely clothed with short, erect pubescence; ocelli large, anterior and lateral ocelli separated by less than twice their diameters; supra-antennal area closely, coarsely punctate; sides of face at clypeal margin with a broad tooth.

TYPE: *Neopasites* (*Odontopasites*) *arizonicus* Linsley.

Distinguished from *Trichopasites* by the larger ocelli, shorter pubescence of the eyes, punctate supra-antennal area and dentate sides of the face. *Neopasites* s. str. lacks the pilose eyes and dentate face but is otherwise similar. Only one species assignable to this subgenus is known at present.

Neopasites (Odontopasites) arizonicus Linsley

1942. *Neopasites* (*Odontopasites*) *arizonicus* Linsley, Pan-Pac. Ent., XVIII, p. 129. ♀, ♂.

Female.—Color black, antennae, legs, and tegulae piceous or reddish, abdomen red; pubescence white, scale-like, forming patches on head, thorax, and abdominal tergites.

Head with a dense patch of white pubescence about bases of antennae; antennae with first flagellar segment a little shorter than following two together; vertex coarsely, subcontiguously punctured; labrum reddish, carinate for more than two-thirds its length; underside of head on each side of gular groove very closely punctate, punctures all less than one puncture width apart; mandibles pale reddish, base piceous.

Text-figure 1.—*Neopasites* (*Odontopasites*) *arizonicus* Linsley, ♂. (× 11)

Thorax coarsely, closely punctate; pronotal tubercles densely clothed with white pubescence; mesoscutum with a small patch of white pubescence on median line at anterior margin, another beside tegulae, and a transverse line along apical margin at middle; mesoscutellum and metanotum with a dense white patch at each side; mesepisterna with a broken band of white pubescence along anterior, dorsal, and ventral margins of vertical face.

Wings pale brownish; first submarginal cell much longer than second, receiving first recurrent nervure just before apex, second submarginal cell receiving its recurrent nervure at apical one-third.

Legs clothed with short, suberect, pale hairs, with a few irregular patches of white hairs on posterior faces of femora and tibiae.

Abdomen opaque, moderately coarsely, closely punctate; first tergite with a white patch on each side of middle at base and a small lateral white patch on apical margin; tergites two to four with a transverse band of white on each side of middle at base and a small apical patch at sides; sternites thinly pubescent, the pubescence a little denser along basal margins. Length, 6 to 7 mm.

Male.—White pubescence denser; abdomen with white pubescent patches on tergites one to five; pygidial plate about one and one-half times as long as broad, apex broadly rounded. Length, 5 to 7 mm.

Type locality.—Yuma, Arizona.

Additional localities.—ARIZONA: Tucson, (A. K. Fisher), 1 ♀, 1 ♂; Hereford, (W. M. Mann), 1 ♂. LOWER CALIFORNIA: San Pedro, 18 miles south of La Paz, (E. S. Ross and G. E. Bohart), 3 ♂.

Flight period.—May to October.

Subgenus **NEOPASITES** s. str.

1898. *Neopasites* Ashmead, Psyche, VIII, p. 284.
1942. *Neopasites* Linsley, Pan-Pac. Entom., XVIII, p. 127.

Form robust; integument coarsely punctate; eyes bare, not pubescent; ocelli large, anterior and lateral ocelli separated by less than twice their diameters; supra-antennal area closely, coarsely punctate; sides of face at clypeal margin without a broad tooth.

Fourteen species of *Neopasites* s. str. are now known. They may be distinguished as follows.

Key to the Species of the Subgenus Neopasites

Females

1. Ventral surface of head with a few large, scattered punctures; area on each side of gular groove almost impunctate.....2
   Ventral surface of head closely punctured, area on each side of gular groove distinctly, and usually moderately densely, punctate.....3
2. Labrum without a basal carina; abdominal tergites pale reddish, the apical segments clouded with blackish, basal pubescent fasciae of tergites two to four consisting of a transverse band, narrowly interrupted at middle, and a narrow apical band on margin of fourth tergite; 3.75 mm. (Arizona).....*minimus*

Labrum with a conspicuous, polished, median, longitudinal carina over basal two-thirds; abdominal tergites black with apical margins red, basal pubescent fasciae of tergites two to four consisting of four small, well separated spots. 4 mm. (Texas) ..... *carinatus*

3. Fifth abdominal sternite broadly, deeply emarginate at apex 4
Fifth abdominal sternite entire, or feebly impressed or emarginate at apex 6

4. Abdominal tergites dark or stained with blackish, pubescent fasciae of segments two to four consisting of four equidistant basal spots; legs, antennae, and pronotal tubercles reddish; smaller species, less than 6 mm. 5
Abdominal tergites red, pubescent fasciae of segments two to four consisting of a pair of basal spots, one on each side at lateral margin; legs, antennae, and pronotal tubercles black or piceous; larger species, 6.5 to 7.5 mm. (Colorado, Kansas, Iowa) ..... *haematurus*

5. Mesepisterna and mesoscutum rugoso-punctate; pleural fascia very small or evanescent; labrum with a median longitudinal carina over two-thirds its length; 5 to 5.5 mm. (Rocky Mts. to Illinois) ..... *heliopsis*
Mesepisterna and mesoscutum distinctly punctured, the punctures separated, the interspaces shining; pleural fascia large, conspicuous; labrum without a median carina, 5 mm. (Colorado, New Mexico). *pulchellus*

6. Abdominal segments red, at most vaguely clouded with black on disk 7
Abdominal segments black or brownish black; mesepisterna with distinct, separate punctures and a large, irregular patch of white pubescence; 4.5 to 5.5 mm. (Colorado to Alberta) ..... *robertsoni*

7. Labrum without a median basal tubercle 8
Labrum with a median thorn-like tubercle at base; first flagellar segment slightly longer than second; pubescent abdominal fasciae small, rounded or subtriangular, paired at base and apical margin of tergites one to four; 6.5 mm. (Texas) ..... *acanthochilus*

8. Abdomen with two transverse patches of white pubescence at base of tergites two to four 9
Abdomen with four more or less equidistant suboval or subtriangular patches of white pubescence at base of tergites two to four; first flagellar segment about as long as following two together; mesoscutum and mesepisterna coarsely and more or less rugosely punctate; 4.5 to 6 mm. (Iowa and Kansas) ..... *calliopsidis*

9. Antennae with first flagellar segment as long as, or slightly longer than, following two together; mesoscutum and mesepisterna distinctly punctate, the punctures slightly separated, interspaces shining; smaller species, 4 to 5 mm. (Illinois to Atlantic Coast) ..... *illoiensis*
Antennae with first flagellar segment shorter than following two together; mesoscutum and mesepisterna rugoso-punctate, surface more or less opaque; larger species, 5.5 to 6 mm. (Nebraska to Alberta). *stevensi*

Males

1. Pygidial plate subtriangular; apical margin of sixth abdominal tergite with a median triangular projection.....2
   Pygidial plate parallel-sided or more or less liguliform; apical margin of sixth abdominal tergite truncate or bisinuate.....3
2. Labrum with a small median tubercle at base; abdominal tergites entirely reddish; slender species, 5.5 mm. (Texas).....*texanus*
   Labrum without a median basal tubercle; abdominal tergites with a median dark cloud on disk; robust species, 6 mm. (Texas).....*eamia*
3. Abdomen black or brownish-black.....4
   Abdomen red, at most with disk or apical tergites blackish.....7
4. Basin of abdomen not sharply defined, punctured, at least at sides; mesepisterna rugoso-punctate, pubescent fascia very small or lacking.....5
   Basin of abdomen sharply defined, impunctate and polished; mesepisterna distinctly punctured, pubescent fascia large, irregular.....6
5. Abdominal truncation broadly arcuate; pygidial plate with sides parallel, apex broadly rotundate-truncate; smaller species, 5 mm. (Rocky Mts. to Illinois).....*heliopsis*
   Abdominal truncation subangulate at middle; pygidial plate with sides slightly arcuate, apex narrowly, evenly rounded; larger species, 7 mm. (Colorado).....*lutzi*
6. Pygidial plate narrowly, evenly rounded at apex, nearly three times as long as broad; antennae, legs, and pronotal tubercles red, abdominal tergites margined with red; vertical face of mesepisterna entirely white pubescent; 5 mm. (Colorado to Alberta).....*robertsoni*
   Pygidial plate about one and one-half times as long as broad, apex broadly rounded; antennae, legs, and pronotal tubercles black, abdominal tergites margined with testaceous; vertical face of mesepisterna margined with white pubescence; 5 mm. (Colorado and New Mexico). *pulchellus*
7. Sixth abdominal tergite truncate at apex; antennal flagellum reddish; smaller, less robust species.....8
   Sixth abdominal tergite bisinuate at apex; antennal flagellum black; pubescent fasciae of abdomen rounded or subtriangular, consisting of four, more or less equidistant patches; pygidial plate and apical tergite black; larger, more robust species, 6.5 to 7 mm. (Colorado, Kansas, Iowa).....*haematurus*
8. Upper frons and vertex coarsely punctate, punctures of ocellocular area approximately equal in size to those of mesoscutum.....9
   Upper frons and vertex finely punctate, punctures of ocellocular area about one-half as large as those of mesoscutum; antennae with first flagellar segment at least as long as following two together; abdomen with two transverse bands of white pubescence at base of tergites two to five (or six); pygidium about one and one-half times as long as broad, apex broadly rounded (District of Columbia).....*punctulatus*

9. Abdomen with two transverse bands of white pubescence at base of tergites two to five (or six) 10
   Abdomen with four more or less equidistant patches of white pubescences at base of tergites two to five (or six); first flagellar segment at least as long as following two together; mesoscutum and mesepisterna coarsely and more or less rugosely punctate; labrum not carinate; 4.5 to 6 mm. (Iowa and Kansas) ..... *calliopsidis*
10. Antennae with first flagellar segment as long as, or longer than, following two together; labrum not distinctly carinate; mesoscutum and mesepisterna distinctly punctate; smaller species, 4.5 to 5 mm. (Illinois to Atlantic Coast) ..... *illinoiensis*
    Antennae with first flagellar segment shorter than following two together; labrum distinctly carinate; mesoscutum and mesepisterna more or less rugoso-punctate; larger species, 5.5 to 6 mm. (Nebraska to Alberta) ..... *stevensi*

Neopasites (Neopasites) minimus new species

Smaller than any of the other known species and distinguished from all except *carinatus* by the sparsely punctured ventral surface of the head. Differing from *carinatus* in the absence of a carina from the labrum, the general coloration, and punctation of the head, thorax and abdomen.

Female.—Color black, abdomen red; pubescence white, forming patches on head, thorax, and abdominal tergites.

Head with a median white fascia on face, surrounding bases of antennae; antennae with first segment of flagellum shorter than the following two together; upper frons and vertex closely, coarsely punctured; anterior ocellus separated by its own diameter from lateral ocelli; clypeus more finely punctured than vertex, the punctures very close, anterior margin reddish; mandibles and labrum pale reddish, the latter with an inconspicuous median tubercle at base; under surface of head with a few scattered punctures.

Thorax coarsely, deeply punctured, the punctures nearly contiguous, interspaces shining; mesoscutum with a large patch of white pubescence at each anterior angle, a smaller median patch on anterior margin, and a narrow white line along lateral margins; mesoscutellum and metanotum with a patch of white pubescence at each side, the former with a line along posterior margin; mesepisternum densely pubescent, the punctures obscured; mesosternum rufo-piceous, glabrous, closely, coarsely punctured.

Propodeum coarsely, closely punctured, triangular area glabrous, shining, impunctate, very minutely tesselate.

Wings subhyaline, veins brownish.

Legs with a few scattered suberect hairs, posterior faces of femora and tibiae with irregular patches of white pubescence.

Abdomen opaque, indistinctly clothed with short, sparse, pale hairs; basin of first tergite moderately well defined, with a large white fascia on each

side; dorsal fasciae of second and third tergites transverse, moderately narrowly interrupted at middle, nearly attaining lateral margins, lateral apical fasciae small; fourth tergite with a transverse white band at base and apex, the former narrowly interrupted at middle; fifth tergite without an apical hair fringe; fifth sternite with a vague, median longitudinal impression, apex broadly rounded, not emarginate. Length, 3.5 mm.

Holotype.—Female; sixteen miles South of Tucson, Arizona; August 11, 1924; (E. P. Van Duzee); [California Acad. Sci. Ent., no. 4353].

Neopasites (Neopasites) carinatus new species

Distinguished from *minimus* by the carinate labrum, dark abdominal tergites with pubescent patches small, not transverse, the more sparsely punctured frons, more coarsely punctate mesoscutum, darker wings, etc.

Female.—Color black, mandibles, apex of femora, base and apex of tibiae, margins of abdominal tergites and sternites more or less reddish; pubescence white, scale-like, forming dense patches on head, thorax and abdomen.

Head with a rosette of white pubescence around antennal bases and a small indistinct patch behind apex of eye; antennae dark brownish, with first flagellar segment distinctly shorter than following two together; upper frons and vertex coarsely but not closely punctate; anterior ocellus separated by its own diameter from lateral ocelli; clypeus more finely punctate than vertex, anterior margin narrowly reddish; mandibles pale reddish, dark at base and apex; labrum dark brown, apex pale reddish, surface finely punctate, distinctly carinate over approximately two-thirds of its length; under surface of head with a few scattered coarse punctures, interspaces polished, minutely punctate.

Thorax coarsely closely punctate; pronotal collar densely clothed with white pubescence, pronotal tubercles reddish, nearly bare; mesoscutum more coarsely, densely punctate than upper frons and vertex, nearly glabrous; mesepisterna and mesosternum nearly glabrous, punctured much like upper frons and vertex; mesoscutellum and metanotum subglabrous, coarsely, closely punctate.

Wings lightly infuscated, veins brownish.

Legs finely punctate, sparsely pubescent.

Abdomen opaque; tergites black, with a broad, pale reddish, apical and lateral margin, surface coarsely punctate except reddish posterior and lateral margins and anterior margin in front of a broadly arcuate, transverse carina, tergites one to four with a small, basal sublateral patch of white pubescence on each side, larger on first tergite; sternites dark with a broad, pale apical margin, dark surface coarsely punctate, clothed posteriorly with a few long, suberect, pale hairs, fifth sternite feebly impressed, margin entire. Length, 4 mm.

Holotype.—Female; Hidalgo County, Texas; July 30, 1938; (R. H. Beamer); [University of Kansas].

Neopasites haematurus (Cockerell and Hicks)

1926. *Holcopasites haematurus* Cockerell and Hicks, Ent. News, XXXVII, p. 107, 1926. ♂.

1928. *Holcopasites haematurus* Cockerell, Univ. Colo. Studies, XVI, p. 111. [Record.]

This species may be easily known by the large size, robust form and general color pattern.

Female.—Color black, abdomen red, tegulae rufopiceous.

Head with a denser patch of white pubescence on each side of face above clypeus and partially surrounding antennal bases, remaining surface more sparsely white pubescent; antennae black, first segment of flagellum shorter than following two together; vertex coarsely closely punctate; anterior ocellus separated by its own diameter from lateral ocelli; clypeus very closely, continguously, or more or less rugosely, punctate, with a narrow, polished, anterior margin; labrum black, with at most a short subbasal carina, base pubescent; mandibles red, base black.

Thorax coarsely, closely punctate; pronotum, except tubercles, white pubescent; mesoscutum coarsely and more or less contiguously punctate, margins with a thin indistinct line of white pubescence; mesoscutellum coarsely, closely punctate, margined with white pubescence; mesepisterna coarsely, closely punctate, anterior angle narrowly white pubescent.

Wings moderately infuscated, veins brown to black.

Legs black, finely punctate; posterior face of tibia clothed with short, dense, velvety pile.

Abdomen opaque, red; tergites two and three with a distinct, four with a vague, dorsal white patch on each side of middle, lateral apical patches distinct on tergites two to four; sternites coarsely punctate, thinly pubescent on basal elevation, polished, paler, minutely tessellate on broad apical margin, fifth sternite broadly, rather deeply emarginate at apex. Length, 6.5 to 7.5 mm.

Male.—Abdomen with a dark area at middle of fifth tergite, apical tergites and pygidial plate black; tergites two to five with basal and lateral patches of white hair; pygidial plate parallel-sided, apex broadly rounded; sternites with narrow, white hair bands. Length, 7 mm.

Type locality.—Boulder, Colorado.

Additional localities.—IOWA: Sioux City, (C. N. Ainslee), 2 ♀; Sergeant Bluff, (G. O. Hendrickson), 1 ♀, 1 ♂; KANSAS: Atchison Co., (E. P. Breakey), 1 ♀.

Flight period.—June and July.

Flower records.—"Boraginaceous plant," (Cockerell and Hicks).

Neopasites heliopsis (Robertson)

1897. *Ammobates heliopsis* Robertson, Trans. Acad. Sci. St. Louis, VII, p. 350. ♂.
1903. *Neopasites heliopsis* Crawford, Can. Entom., XXXV, p. 334. [Record.]
1907. *Neopasites heliopsis* Swenk, Entom. News, XVIII, p. 298. [Record.]
1910. *Holcopasites heliopsis* Cockerell, Univ. Colo. Studies, VII, p. 190, Fig. 15.
1915. *Holcopasites heliopsis* Crawford, Ins. Insc. Mens., III, p. 124.
1928. *Holcopasites heliopsis* Cockerell, Univ. Colo. Studies, XVI, p. 111. [Record.]

Readily distinguished among the species with a dark abdomen by the coarse, rugose punctation of the thorax and reduced pubescent fascia of the mesepisterna.

Female.—Color black, antennae, clypeus, mouthparts, pronotal tubercles, tegulae, legs and posterior margins of abdominal segments reddish.

Head sparsely pubescent, with a thin patch of white hairs about antennal bases and laterad to apex of eye, and a median line running dorsally through median ocellus; frons and vertex coarsely, closely punctate, opaque; antennae with first flagellar segment distinctly shorter than following two together; clypeus closely, coarsely punctate at base, more finely toward apex, elevated apical margin smooth, shining; labrum with a tuft of long white hairs at base, surface longitudinally carinate for about two-thirds its length; mandibles pale reddish, base and apex piceous.

Thorax coarsely punctate; mesoscutum coarsely, rugosely punctate, opaque, anterior half of median line and anterior margin in front of parapsidal furrows white pubescent; mesoscutellum deeply bilobed, punctured like mesoscutum, lobes margined with white; metanotum white pubescent at sides and middle; mesepisterna with vertical face rugoso-punctate, anterior angle narrowly white pubescent, median pubescent fascia very small or evanescent; mesosternum more or less margined with white; metasternum white pubescent.

Wings lightly infuscated, veins and stigma brownish.

Legs sparsely pubescent, reddish or rufo-piceous; posterior femora with a small patch of white pubescence at apex.

Abdomen black or very dark brown, opaque, very closely punctate, apical margins of tergites and sternites reddish; elevated portion of first tergite with an arcuate white band on each side of middle extending forward to basal concairty and turning laterally toward margin; tergites two to four with four nearly equidistant patches of white pubescence on apical margin; fifth sternite broadly, deeply emarginate at apex.

Male.—Length 5 mm. Generally similar in color to female but with arcuate white patch of first abdominal tergite smaller and basal white patches present on tergites two to five; pygidial plate about twice as long as broad, apex broadly rounded. Length, 5 to 5.5 mm.

Type locality.—Carlinville, Illinois.

Additional localities.—MONTANA: [Acad. Nat. Sci. Phila.]. NORTH DAKOTA: Winnecock, (S. S. Berry); Fargo, (O. A. Stevens); Minot, (O. A. Stevens); McKenzie, (O. A. Stevens); Mott, (O. A. Stevens); Marmarth, (O. A. Stevens); Nicholson, (O. A. Stevens). NEBRASKA: Lincoln, (W. D. Pierce, J. C. Crawford); West Point, (J. C. Crawford). IOWA: Sioux City, (C. N. Ainslee). COLORADO: Boulder, (C. H. Hicks). ARKANSAS: Onachita Mts., 25 miles north of Fort Smith, (E. C. VanDyke). CANADA: Medicine Hat, Alberta, (Sladen); Lethbridge, Alberta, (Sladen).

Flight period.—July and August.

Material studied.—Fourteen females, seven males.

Flower records.—*Mentha canadensis* (S. S. Berry); *Grindelia squarrosa* (O. A. Stevens); *Brauneria pallida* (O. A. Stevens); *Ratibida columnaris* (O. A. Stevens).

Neopasites robertsoni Crawford

1906. *Neopasites robertsoni* Crawford, Can. Entom., XXXVIII, p. 283. ♀, ♂.
1907. *Neopasites robertsoni* Swenk, Entom. News, XVIII, p. 298. [Record.]
1911. *Neopasites robertsoni* Cockerell, Can. Entom., XLIII, p. 390. [Record.]
1915. *Holcopasites robertsoni* Crawford, Ins. Insc. Mens., III, p. 124. ♀, ♂. [Key.]
1928. *Holcopasites robertsoni* Cockerell, Univ. Colo. Studies, XVI, p. 111. [Record.]
1933. *Holcopasites robertsoni* Popov, Trav. Inst. Zool. Acad. Sci. U. R. S. S., II, p. 62, fig. 6. ♂.

Very similar in general appearance to *heliopsis* but less closely, not rugosely punctate, and with the vertical face of the mesepisterna densely white pubescent. The female may be further distinguished by the more feebly impressed fifth abdominal sternite, the male by the more elongate and narrowly rounded pygidial plate.

Female.—Color black, antennae, mandibles, pronotal tubercles, tegulae, legs, and posterior margins of abdominal segments more or less reddish.

Head with a patch of dense white pubescence around bases of antennae, a small patch laterad to apex of eye; supra-antennal area finely punctate, finely clothed with short, silky brownish pubescence; vertex more coarsely, closely punctate; antennae with first flagellar segment much shorter than following two together; clypeus finely, closely punctate; labrum with a patch of long, erect, pale hairs at base; mandibles with base black, apex piceous, intermediate area pale reddish.

Thorax moderately closely punctate; pronotal tubercles piceous, more or less pubescent; mesoscutum moderately coarsely, closely punctate, anterior

parts of median and parapsidal grooves white pubescent; mesoscutellum deeply bilobed, lobes margined with white pubescence; mid-line of metanotum white pubescent; mesepisterna with vertical face densely white pubescent, ventral face moderately closely punctate but shining; mesosternum largely white pubescent; metasternum and lateral face of posterior coxae white pubescent.

Wings lightly infuscated, stigma and veins brownish.

Legs sparsely pubescent, reddish or fuo-piceous; posterior femora with a small patch of white hairs at apex.

Abdomen black or dark brownish, opaque, closely punctate, apical margins of tergites and sternites reddish or golden, clothed with fine, golden or reddish brown pubescence; first tergite with an elongate, broad patch of dense white pubescence on each side of middle extending forward to basal concavity then lateral in a broken manner around edge of concavity to connect with small patches on lateral margin; tergites two to four with four patches of white pubescence on basal margin, the median two a little more widely separated; fifth sternite impressed at apex but margin more or less entire. Length, 4.5 to 5.5 mm.

Male.—Generally similar in color to female but dorsal white patch of first tergite smaller and basal white patches present on tergites two to five, vaguely represented on tergite six; pygidial plate two and one-half to three times as long as broad. Length, 4.5 to 5.5 mm.

Type locality.—Lincoln, Nebraska.

Additional localities.—NEBRASKA: West Point, (J. C. Crawford). NORTH DAKOTA: Valley City, (O. A. Stevens); Bismark, (O. A. Stevens); McKenzie, (O. A. Stevens); Drake, (O. A. Stevens); Fargo, (O. A. Stevens); Manden, (O. A. Stevens); Wales, (O. A. Stevens); Mott, (O. A. Stevens); Marmarth, (O. A. Stevens); Tollig, (O. A. Stevens); Minot, (O. A. Stevens). COLORADO: Boulder, (C. H. Hicks). CANADA: Prince Albert, Alberta, (Sladen).

Flight period.—July and August.

Flower records.—*Solidago* sp., (J. C. Crawford, O. A. Stevens); *Solidago canadensis,* (Sladen); *Grindelia squarrosa,* (O. A. Stevens); *Erigeron philadelphieus,* (O. A. Stevens); *Chrysopsis,* (O. A. Stevens); *Brauneria pallida,* (O. A. Stevens).

Material studied.—Sixteen females, twelve males.

Neopasites robertsoni pubescens new subspecies

Generally similar to *robertsoni* s. str. but more densely pubescent with a somewhat ashy appearance, darker legs, and a shorter, broader pygidial plate. Length, nearly 5 mm.

Holotype.—Male; Gallina Creek, Jemez Mountains, New Mexico; altitude 8,500 ft.; July 24, 1930; (J. C. Chamberlin); [Calif. Acad. Sci., Ent., no. 4353].

Only a single specimen of this form has been available for study and it is not possible to determine its status satisfactorily at present. It may eventually prove to be a distinct species.

Neopasites lutzi (Cockerell)

1934. *Holcopasites lutzi* Cockerell, Am. Mus. Nov., No. 697, p. 12.

"Related to *heliopsis* and *robertsoni* but considerably larger, with the pleura differently marked, and other differences. The pattern of the abdomen is much like that of *heliopsis*."

Male.—"Length a little over 7 mm.; robust, black, with the pubescence white; eyes pale brown; face broad; dense white hair at sides near antennae, and more narrowly across lower end of supraclypeal area, forming a sort of band; clypeus excessively densely punctured, with a shining margin; labrum black, with a band of white hair, and a small basal appressed spine-like structure; mandibles dusky red, black at end; flagellum dusky red beneath; vertex broad and dull, with a minute shining spot on each side, simulating an extra pair of ocelli; a thin band of dull white hair extends up to middle ocellus, and behind ocelli a band of scattered pale fulvescent scales extends back to occipital margin, and is in line with an exactly similar band on middle of mesothorax, which, however, is lacking on nearly the posterior half, though continued across the rough bigibbous scutellum; tubercles red; mesopleura dull black, with only a small spot of light hair in middle; tegulae rather dark red; wings dilute fuliginous, with dark stigma and nervures; first recurrent meeting first intercubitus; legs mainly black, the grayish pubescence on hind tibiae producing a speckled effect; anterior tibiae red at extreme base, and slightly so at apex; hind knees red; tarsi dark; abdomen broad, hind margins of tergites with bright red bands; basin of first tergite sharply defined, angulate above, and with a shining sulcus in middle; first tergite dorsally with a pair of elongate white hair spots; tergites 2 to 6 each with four spots; apical plate brown; venter with fine whitish tomentum."

Type locality.—Wray, Colorado.

Flight period.—August.

Neopasites pulchellus (Cresson)

1878. *Phileremus? pulchellus* Cresson, Trans. Amer. Ent. Soc., VII, p. 84, ♀, ♂.

1896. *Ammobates pulchellus* Dalla Torre, Cat. Hymen., X, p. 498.

1898. *Phileremus pulchellus* Cockerell, Bull. Sci. Lab. Denison, Univ., I, p. 60.

1910. *Holcopasites pulchellus* Cockerell and Robbins, Univ. Colo. Studies, VII, p. 190. [Record.]

1915. *Holcopasites pulchellus* Crawford, Ins. Insc. Mens., III, p. 123. ♀, key.
1928. *Holcopasites pulchellus* Cockerell, Univ. Colo. Studies, XVI, p. 111. [Record.]

Female.—"Black, opaque, densely punctured; head broader than thorax; face, sides of occiput, margin of thorax above, sides of metathorax and large patch beneath wings clothed with short, appressed, white, scale-like pubescence; mandibles, tegulae, and tubercles, ferruginous; flagellum brown; wings hyaline, faintly dusky at tips, marginal cell as long as the two submarginal cells, rounded at tip, second submarginal cell less than half the length of the first, narrowed nearly to a point toward marginal, receiving the second recurrent nervure a little beyond the middle, the first recurrent is received by the first submarginal near its apex or junction with the second; legs with short, pale, glittering hairs, the femora at tips and the tibiae more or less varied with ferruginous; tibiae spinulose on outer edge; abdomen ovate, very densely and confluently punctured, opaque, fulvo-ferruginous, the segments above stained with black on the middle, a circular line on each side of first segment, and four equidistant spots at base of segments 2–5 composed of appressed white scales; fifth segment longitudinally carinate on the disk; venter fulvo-ferruginous, spotted laterally with fuscous, apical segment emarginate at tip. Length, .20 inch.

Male.—"Like the ♀ except that the ferruginous color entirely disappears and the head thorax and abdomen above are yellowish-brown; apical margin of abdominal segments obscurely pale testaceous. Length, .23 inch."

Type locality.—Colorado.

Other localities.—COLORADO: Colorado Springs, (Cockerell); Denver, (E. C. Jackson). NEW MEXICO: Cimarron, (W. R. Walton); Las Vegas, (H. S. Barber).

Flight period.—June to August.

Neopasites illinoiensis (Robertson)

1891. *Phileremus illinoiensis* Robertson, Trans. Amer. Ent. Soc., XVIII, p. 64. ♀.
1896. *Ammobates illinoiensis* Dalla Torre, Cat. Hymen., X, p. 497.
1915. *Holcopasites pratti* (Ashmead ms.) Crawford, Ins. Insc. Mens., III, p. 123. [Nomen nudum.]
1915. *Holcopasites illinoiensis* Crawford, Ins. Insc. Mens., III, p. 124. ♀, ♂. [Key.]
1916. *Neopasites illinoiensis* Viereck, Conn. Geol. Nat. Hist. Surv., Bull. no. 22, p. 370. [Record.]
1923. *Holcopasites illinoiensis* Bequaert, Bull. Brooklyn Ent. Soc., XVIII, p. 171.
1939. *Neopasites illinoiensis* Linsley and Michener, Trans. Amer. Ent. Soc., LXV, pls. 15 to 18. [Anat.]

Female.—Color black, mandibles and abdomen red.

Head coarsely, distinctly punctate, with a patch of white pubescence around antennal bases, another behind apex of eye; antennae with first flagellar segment at least as long as following two together; upper frons and vertex closely but distinctly punctate, punctures about as large as those of mesoscutum; clypeus more finely punctate labrum finely closely punctate at base, longitudinally carinate; mandibles pale rufotestaceous, apex piceous.

Thorax coarsely punctate; pronotal tubercles black, narrowly margined with white pubescence; tegulae piceous, outer margin paler; mesoscutum closely but distinctly punctate, anterior angles and anterior part of median line, white pubescent; mesoscutellum coarsely, closely punctate, feebly bilobed, lobes margined with white pubescence; metanotum with a patch of white hairs at middle and sides; mesepisterna with vertical face coarsely, closely, but distinctly punctate, irregularly margined with white pubescence.

Wings lightly infuscated, veins and stigma dark brown.

Legs black, joints often reddish.

Abdomen red, disk of tergites often clouded with fuscous, posterior depressed margin golden; first tergite with basal concavity thinly white pubescent, a large pubescent white patch bordering lateral margin, tergites one to four with an apical patch of white hairs on lateral margin, two to four with a transverse white band of pubescence on basal margin; fifth sternite feebly emarginate at apex. Length, 4.5 to 5 mm.

Male.—Generally similar to female; labrum scarcely carinate; pubescent fasciae of abdomen more transverse, present also on tergites five and six; pygidial plate nearly twice as long as broad, apex narrowly rounded.

Type locality.—Carlinville, Illinois.

Other localities.—ILLINOIS: Dubois, [Ill. Nat. Hist. Survey]. NEW YORK: Huntington, L. I., (J. C. Bridwell); White Plains, (J. R. de la Torre Bueno). MASSACHUSETTS: Dover, (J. Bequaert). VIRGINIA: Barcroft, (W. L. McAtee, P. H. Timberlake). DISTRICT OF COLUMBIA: Washington, (W. H. Ashmead). CONNECTICUT: New Haven, (B. H. Walden). NORTH CAROLINA: Bryson City, (J. C. Crawford). MISSISSIPPI: Agricultural College, (W. D. Pierce).

Flight period.—June to September.

Flower records.—*Lespedeza procumbens,* (C. Robertson); *Lespedeza repens,* (J. C. Crawford); *Ceanothus americanus,* (W. L. McAtee); *Coreopsis verticillata,* (P. H. Timberlake); *Chrysopsis mariana,* (McAtee).

Material examined.—Seven females, three males.

Neopasites punctulatus new species

Related to *illinoiensis* but more robust and differing in the finely punctate upper frons and vertex (punctures of ocell-ocular area about half as large as those of mesoscutum), the scarcely bilobed, opaque, contiguously punctate mesoscutellum, and the short broad pygidial plate (about one and one-half times as long as broad with apex narrowly rounded).

Male.—Color black, abdomen red, antennae, mandibles, knees, and tegulae more or less reddish.

Head moderately finely punctate, sparsely pubescent, a patch of white hairs around antennal bases, another behind apex of eyes; antennae with first four segments dark, first flagellar segment about as long as following two together; upper frons and vertex opaque, finely punctate, punctures of ocellocular area about half as large as those of mesoscutum; clypeus opaque, rather finely punctate; labrum piceous, apparently not carinate; mandibles pale reddish, base rufo-piceous.

Thorax coarsely punctate; pronotal tubercles black; tegulae rufo-piceous, outer margin paler; mesoscutum coarsely, very closely punctate but interspaces shining; mesoscutellum opaque, very coarsely, contiguously and subcontiguously punctate, surface more or less evenly convex, scarcely bilobed, margined with white pubescence, denser laterally; mesepisterna with vertical face opaque, closely punctate, irregularly margined with white pubescence, more broadly and densely below.

Wings very lightly infuscated, veins and stigma pale brown.

Legs with femora clothed ventrally with white pubescence; tibiae thinly clothed with white hairs.

Abdomen red, tergites two to four and apical tergites almost wholly clouded with black; first tergite with a large patch of white pubescence adjacent to lateral apical margin of concavity, tergites two to six with a narrow line of white along basal margin, interrupted at middle, tergites two to four with a patch of white pubescence at lateral apical margin, tergite five with a narrow line of white along posterior margin; pygidial plate red, broad, about one and one-half times as long as broad, apex narrowly rounded. Length, 5 mm.

Holotype.—Male; Chevy Chase, District of Columbia; June 14, 1916; (W. D. Pierce; at flowers of Erigeron ramosus); [Academy of Natural Sciences of Philadelphia; Type No. 5012].

Neopasites stevensi (Crawford)

1903. *Neopasites illinoiensis* Crawford (not Robinson), Can. Entom., xxxv, p. 334. [Record.]

1907. *Heopasites illinoiensis* Swenk (not Robinson), Entom. News, xviii, p. 297. [Record.]

1912. *Neopasites illinoiensis* Crawford (not Robinson), Can. Entom., XLIV, p. 369. [Record.]
1915. *Neopasites stevensi* Crawford, Ins. Insc. Mens., III, p. 125. ♀, ♂.

Distinguished from *illinoiensis* by the larger size, rugose punctation, carinate labrum and shorter first segment of the antennal flagellum.

Female.—Color black, mandibles and abdomen red.

Head coarsely, closely punctate, with a patch of white pubescence around antennal bases, another behind apex of eye; antennae with first flagellar segment shorter than following two together; upper frons and vertex more or less rugoso-punctate, punctures about as large as those of mesoscutum; clypeus more finely, closely punctate; labrum at most feebly carinate; mandibles pale rufotestaceous, apex piceous.

Thorax coarsely punctate; pronotal tubercles black, narrowly margined with white pubescence; tegulae piceous; mesoscutum coarsely rugoso-punctate, anterior angles and anterior part of mid-line, white pubescent; mesoscutellum rugoso-punctate, distinctly bilobed, lobes sometimes more or less margined with white; metanotum with sides white pubescent; mesosternum with vertical face coarsely rugoso-punctate, irregularly margined with white pubescence.

Wings lightly infuscated, veins and stigma dark brown.

Legs black or piceous; femora white pubescent beneath; tibiae thinly clothed with white pubescence.

Abdomen red, disk of tergites often clouded with fuscous, posterior depressed margin golden; first tergite with basal concavity very thinly pubescent, a large pubescent white patch bordering lateral margin, tergites one to four with an apical patch of white hairs on lateral margin, two to four with a small, transverse white patch on each side about half way between middle and lateral margin; fifth sternite feebly emarginate at apex. Length, 6 mm.

Male.—Generally similar to female; labrum with a distinct longitudinal carina; pubescent fasciae present also on tergites five and six; pygidial plate about one and one-half times as long as broad, apex broadly rounded.

Type locality.—Bismarck, North Dakota.

Other localities.—NORTH DAKOTA: McKenzie, (O. A. Stevens); Minot, (O. A. Stevens); Drake, (O. A. Stevens); Williston, (O. A. Stevens); Fargo, (O. A. Stevens). NEBRASKA: West Point, (J. C. Crawford); Lincoln, (J. C. Crawford). CANADA: Medicine Hat, Alberta, (J. R. Malloch).

Flower records.—*Grindelia squarrosa,* (O. A. Stevens, J. C. Crawford); *Solidago rigida,* (J. C. Crawford).

Material examined.—Five females and four males.

Neopasites calliopsidis new species

1933. *Holcopasites stevensi* Popov (not Crawford), Trav. Inst. Zool. Acad. Sci. U. R. S. S., II, p. 62, figs. 5, 7. ♂.

1937. *Holcopasites stevensi* Ainslie (not Crawford), Can. Entom., LXIX, p. 99. [Habits.]

1937. *Holcopasites illinoiensis* Ainslie (not Robertson), Can. Entom., LXIX, p. 255.

Of the size and form of *stevensi* but with the mesoscutum and mesepisterna less strongly rugoso-punctate, the first flagellar segment as long as the following two together, the labrum without a longitudinal carina and the abdomen with four (rather than two) more or less equidistant patches of white pubescence on tergites two to four (♀), two to six (♂).

Female.—Color black, abdomen, mandibles red.

Head coarsely punctate, with a patch of white hairs on each side of antennal bases and behind apex of eye; antennae brownish above, first flagellar segment as long as following two together; upper frons and vertex coarsely, contiguously and subcontiguously punctate, punctures of ocellocular area about as large as those of mesoscutum; clypeus closely but more finely punctate; labrum with a smooth median line at base but no carina; mandibles pale reddish, apex piceous.

Thorax coarsely punctate; pronotal tubercles black; tegulae piceous, outer margin reddish; mesoscutum coarsely, more or less rugosely punctate, anterior angles and anterior part of mid-line white pubescent; mesoscutellum coarsely, closely punctate, feebly bilobed, anterior angles and posterior midline white pubescent; metanotum with a patch of white hairs at middle and sides, mesepisterna with vertical face coarsely, closely, more or less rugosely punctate, irregularly margined with white pubescence.

Wings lightly infuscated, veins and stigma brown.

Legs black, thinly pubescent; anterior and intermediate femora white pubescent beneath at apex.

Abdomen red, disk of tergites clouded with black; first tergite with a large white pubescent patch bordering lateral margin of concavity, two to four with four more or less equidistant, triangular or suboval patches on basal margin, one to four with a patch on lateral apical margin, the fourth also with a patch on apical margin on each side of middle; fifth sternite feebly impressed at apex, margin nearly entire. Length, 4.5 to 6 mm.

Male. Generally similar to female, pubescent pattern of abdomen continued on to fifth tergite, less distinctly on to sixth tergite; pygidial plate about one and one-half times as long as broad, apex broadly rounded. Length, 4.5 to 6 mm.

Holotype.—Female; Sioux City, Iowa; June 9, 1931, (C. N. Ainslee); [Academy Natural Science of Philadelphia, no. 5013].

Allotype.—Male; same data, mounted on same pin which bears label "apparently mating."

Paratypes.—14 females and 4 males, from the type locality on various dates in June and July between 1924 and 1937 (C. N. Ainslee). Paratypes in the collection of the California Academy of Sciences, Academy of Natural Sciences of Philadelphia, O. A. Stevens, P. H. Timberlake, and the writer.

Additional localities.—MONTANA: Forsyth, (C. N. Ainslee). KANSAS: Manhattan, (Sabrosky).

Host.—Calliopsis andreniformis Smith.

Neopasites eamia Cockerell

1909. *Neopasites eamia* Cockerell, Ann. Mag. Nat. Hist., (8) IV, p. 29. ♂.

Male.—Form robust; color black, antennae, mandibles, pronotal tubercles, axillae legs and abdomen wholly or partly red.

Head closely punctate, thinly clothed with brownish pubescence, with a dense patch of white about antennal bases, a thinner patch behind apex of eye; antennae with first flagellar segment a little shorter than following two together; clypeus moderately coarsely, contiguously punctate; labrum piceous, closely punctate without a carina or median basal tubercle; mandibles rufo-piceous at base and apex.

Thorax closely punctate; pronotal collar white pubescent, tubercles red, pubescent at sides; mesoscutum moderately coarsely, subcontiguously punctate, anterior half of median line and margins narrowly lined with coarse white, scale-like hairs; mesoscutellum moderately bilobed, punctured like disk of mesoscutum, margins and median groove lined with white; metanotum thinly clothed with white scales, denser at sides; propodeum with triangular area glabrous; mesepisterna closely punctate, vertical face thinly clothed with white scale-like hairs. Wings dusky, veins and stigma brown to black; first recurrent nervure meeting first transverse cubitus.

Legs red or with the apex of the femora, anterior and intermediate tibiae, posterior tibiae at base and apex, and anterior tarsi, red; tibiae feebly spinulose, thinly pubescent.

Abdomen red, one or more tergites with a median dark cloud, surface opaque, very closely punctate; pubescent patches of first tergite running obliquely along lateral margin of basal concavity, four basal gasciae of tergites two to five more or less equidistant, subtriangular, these same tergites with an apical white patch on lateral margin; sternites with basal elevation dark, thinly clothed with white pubescence; sixth tergite with a triangular process at apex; pygidial plates subtriangular, apex narrowly rounded. Length, 6 to 8.5 mm.

Type locality—Lee County, Texas.

Additional record.—Texas, (Schwarz) 1 ♂.

Flight period.—May and June.

This and the following two species, all from Texas, are at present represented in one sex only.

Neopasites acanthochilus (Crawford)

1915. *Holcopasites acanthochilus* Crawford, Ins. Insc. Mens., III, p. 125. ♀.

Female.—Color black, antennae, mandibles, pronotal tubercles, tegulae, legs and abdomen wholly or partly red.

Head thinly clothed with brownish pubescence, with a large patch of white around antennal bases, a smaller patch outside of apex of eye; antennae brownish above, first flagellar segment shorter than following two together; upper frons and vertex closely punctate; clypeus closely, more finely punctate at middle; lower sides of face adjacent to clypeus shining, with a few scattered punctures; labrum piceous, margined with red, surface closely punctate with an acute median basal tubercle; mandibles pale red, apex and base darker.

Thorax closely punctate; pronotal collar white pubescent, tubercles red, pubescent at margins, apex broadly rounded; mesoscutum very closely punctate, thinly lined with white along lateral margins and anterior part of median line; mesoscutellum bilobed, coarsely, very closely punctate, margins and median groove lined with white; metanotum with sides white pubescent; propodeum with triangular area glabrous; mesepisterna with vertical face rugoso-punctate, thinly clothed with white pubescence.

Wings lightly infuscated, veins and stigma brown; first recurrent nervure received by second submarginal cell near apex.

Legs red, coxae, basal half of femora, apical half of intermediate and posterior tibiae, intermediate and posterior tarsi, piceous or clouded with piceous.

Abdomen red, opaque, closely punctate; first tergite with basal truncation poorly defined and white pubescent, with an oblique white patch along sides adjacent to concavity; tergites two to four with a pair of basal patches of white pubescence, one to four with a lateral apical white patch; sternites with basal elevation clouded with piceous, thinly clothed with pale hairs; fifth sternite impressed at apex, shallowly emarginate. Length, 6 to 6.5 mm.

Type locality.—Clarendon, Texas.

Other localities.—TEXAS: Cypress Mills, 1 ♀; Fedor, (Birkman) 1 ♀; [Acad. Nat. Sci. Phila.] 1 ♀.

Flight period.—June.

Flower records.—*Monardia citriodora* (F. C. Bishopp).

Neopasites texanus (Crawford)

1915. *Holcopasites texanus* Crawford, Ins. Insc. Mens., III, p. 126.

Male.—"Length, 5.5 mm. Head and thorax black, abdomen red, legs brown, darker basally; tibial spurs whitish; antennae brown, darker above and more reddish beneath toward base; tegulae and tubercles ferruginous; head and thorax closely rather coarsely punctured; labrum with a thorn-like projection medially near base; sixth dorsal abdominal segment medially on apical margin with a pygidium-like projection; transverse median vein interstitial; first recurrent vein received by first cubital cell near apex."

Type locality.—Cotulla, Texas.

Flight period.—May.

Flower records.—Verbesina encelioides, (F. C. Pratt); *Monardia punctata,* (F. C. Pratt).

This species has not been recognized by the writer.

A REVISION OF THE GENUS GNATHOPASITES

(HYMENOPTERA: NOMADIDAE)[1]

BY E. GORTON LINSLEY[2]

University of California

(Text-figure)

The genus considered in the present paper is a small one, and, as known at present, is entirely confined to California. Further collecting will probably reveal that its range includes parts of Nevada, Oregon, and perhaps other far-western states.

GNATHOPASITES Linsley and Michener

1939. *Gnathopasites* Linsley and Michener, Trans. Amer. Ent. Soc., LXV, p. 272.
1916. *Neopasites* Crawford (not Ashmead), Ins. Insc. Mens., IV, p. 136.
1923. *Neopasites* Cockerell, Ann. Mag. Nat. Hist., (9), XI, p. 269.
1933. *Neopasites* Popov, Trav. Inst. Zool. Acad. Sci. U. R. S. S., II, p. 62.

Gnathopasites is closely related to the European genus *Biastes* and several of the characters previously utilized for their separation are invalid. Both genera agree in having an inner tooth near the apex of the mandibles and dark wings with a pale area beyond the submarginal and cubital cells, and the maxillary palpi in *Biastes* are composed of four free segments as in *Gnathopasites* s. str. *Biastes* differ, however, in being strongly punctate, much as in *Neopasites* (= *Holcopasites*) and the forms of the sixth abdominal sternite of the female and the genitalia of the male are both quite different.

[1] This is the sixth of a series of articles on North American Nomadidae. For the previous parts see Trans. Amer. Ent. Soc., LXV, pp. 265–305, and 345–362, 1939, LXVI, pp. 307–318, 1941, LXIX, pp. 93–106, 119–140, 1943.

[2] The writer wishes to express his appreciation to Mr. P. H. Timberlake, Dr. C. D. Michener and Dr. R. M. Bohart for the loan of certain of the material used in this study and to Mr. E. T. Cresson, Jr., for notes on the type of *Phileremus fulviventris* Cresson.

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Two subgenera may be recognized as follows:

Maxillary palpi elongate, composed of four free segments; second submarginal cell of anterior wing a little shorter than first; larger species. *Gnathopasites* s. str.

Maxillary palpi short, composed of one or two free segments; second submarginal cell of anterior wing as long as first; smaller species. *Micropasites*

Subgenus **GNATHOPASITES** s. str.

1939. *Gnathopasites* Linsley and Michener, Trans. Am. Ent. Soc., LXV, p. 272.

1942. *Gnathopasites* Linsley, Pan-Pacific Ent., XVIII, p. 130.

Body moderate sized, length 6 to 8 mm.; maxillary palpi elongate composed of four free segments; antennae with first flagellar segment twice as long as pedicel; anterior wings with second submarginal cell a little shorter than first submarginal cell.

TYPE: *Philerimus fulviventris* Cresson.

Only two species assignable to this subgenus are now known. They may be distinguished as follows:

Females

1. Abdomen shining; parapsidal furrows and median line of mesoscutellum not clothed with white pubescence; punctation distinct, interspaces shining, punctures of mesoscutellum twice as large as those of mesoscutum; tibiae largely red. 7.5 to 8 mm. (Coastal California) ..... *fulviventris*

   Abdomen opaque; parapsidal furrows and median line of mesoscutellum clothed with white pubescence; punctation very dense, interspaces at most feebly shining, punctures of mesoscutellum but little larger than those of mesoscutum; tibiae largely black. 5.5 to 6 mm. (Sierra Nevada Mountains) ..... *sierrae*

Males

1. Abdomen red feebly shining; clypeus truncate at apex; pygidial plate distinctly longer than broad, more finely, less closely punctate; scutellum without a median band of white pubescence; all of the tarsal claws bifid at apex. Length 7 to 8 mm. (Coastal California) ..... *fulviventris*

   Abdomen black, opaque; clypeus shallowly notched at apex; pygidial plate but little longer than broad, less finely, more closely punctate; scutellum with a median longitudinal band of white pubescence; only the anterior tarsal claws bifid at apex. Length 6 mm. (Sierra Nevada Mountains) ..... *sierrae*

Gnathopasites (Gnathopasites) fulviventris (Cresson) (Text-figure 1)

1878. *Phileremus fulviventris* Cresson, Trans. Amer. Ent. Soc., VIII, p. 83. ♂.

1896. *Ammobates fulviventris* Dalla Torre, Catal. Hymen., X, p. 497.

1916. *Neopasites fulviventris* Crawford, Ins. Insc. Mens., IV, p. 136. ♂.

1939. *Gnathopasites fulviventris* Linsley and Michener, Trans. Amer. Ent. Soc., LXV, pls. 15–18.

Female. Form moderately robust; color black, mandibles, except base and apex, underside of flagellum, pronotal tubercles, tegulae, trochanters beneath, apices of femora, tibiae and abdomen reddish; integument shining between the punctures; pubescence dominantly white.

Head moderately, finely, closely punctate; pubescence moderately dense on lower half of face and on cheeks, sparse elsewhere; antennae with first flagellar segment a little less than twice as long as second, when viewed from the front.

Text-figure 1.—*Gnathopasites fulviventris* (Cresson), ♀. (× 9).

Thorax moderately, finely, closely punctate; mesoscutum margined with white pubescence; mesoscutellum more coarsely punctate than mesoscutum; metanotum largely white pubescent; propodeum densely white pubescent, triangular area glabrous, moderately, finely, closely punctate.

Wings moderately infuscated except for pale areas in vicinity of submarginal and cubital cells.

Legs thinly pubescent; all the claws armed with an inner tooth.

Abdomen red, basal cavity, discal areas of fifth and sixth tergites, lateral areas of second and third sternites, and most of fourth and fifth sternites clouded with black or piceous; punctation moderately fine, distinct, dense but separated, interspaces shining; lateral and sublateral margins of tergites white pubescent, apical margins of tergites three and four with an oval patch of white pubescence on each side of middle.

Length, 7.5 to 8 mm.

Male. Form similar to that of female; clypeus with anterior margin entire, truncate or shallowly emarginate; legs with all the tarsal claws bifid at apex; abdomen red, finely, closely, distinctly punctate, interspaces shining, apical margin of tergites with a narrow line of white pubescence, expanded as an oval patch on each side of middle on tergites three to five, pygidial plate distinctly longer than broad, finely, moderately closely punctate.

Length, 7 to 8 mm.

Type locality.—California.

Additional localities.—All California: Hastings Natural History Reservation, Jamesburg, Santa Lucia Mountains, Monterey County, (C. D. Michener) 2 ♂, 3 ♀; Siskiyou County, (Nunenmacher) 1 ♀.

Flight period.—May and June.

Host.—Unknown.

The specimen from Siskiyou County (U. S. Nat. Museum) is smaller, with perceptibly lighter wings and the red areas paler, more nearly rufotestaceous.

Gnathopasites (Gnathopasites) sierrae new species

Smaller than *G. fulviventris* Cresson and more densely punctate and opaque. The male differs from that of *fulviventris* by having only the anterior tarsal claws bifid, the clypeus notched at the apex, the pygidial plate but little longer than broad and more closely, less finely punctate. The female has the punctures of the mesoscutellum scarcely larger than those of the mesoscutum and differs in the pubescent pattern of the notum.

Female. Form robust; color black, mandibles, except base and apex, underside of flagellum, pronotal tubercles, tegulae, apex of femora, base and apex of tibiae and abdomen reddish; integument very closely punctate, opaque, puncture interspaces feebly shining; pubescence dominantly white.

Head moderately finely but very closely punctate; pubescence white, moderately dense on lower face and cheeks, sparse on vertex, brownish on upper vertex and occipital region; antennae with first flagellar segment a little less than twice as long as second, when viewed from the front.

Thorax opaque, moderately finely but very densely punctate; mesoscutum vaguely margined with white pubescence, median longitudinal discal line and parapsidal furrows lined with white pubescence; mesoscutellum scarcely more coarsely punctate than mesoscutum; propodeum densely white pubescent, triangular area glabrous, more coarsely, closely punctate in basal and discal areas.

Wings lightly infuscated except for pale areas in vicinity of submarginal and cubital cells.

Legs thinly pubescent, all of the claws armed with an inner tooth. Abdomen red, basal cavity, tergites three to six and sternites two to five clouded with piceous, at least basally, surface opaque, punctation moderately fine but very dense, interspaces at most feebly shining; lateral and sublateral margins of tergites white pubescent, apical margins of tergites vaguely, narrowly white pubescent except on segments three and four which have an oval apical white patch on each side of middle.

Length, 5.5 to 6 mm.

Male. Form similar to female; color black, mandibles at middle, apex of femora, base and apex of tibiae, pronotal tubercles and tegulae rufopiceous; clypeus with a median notch on anterior margin; legs with only the anterior tarsal claws bifid at apex; abdomen black, opaque, closely punctate, puncture interspaces only feebly shining, apical margin of tergites with a narrow line of white pubescence, expanded as an oval patch on each side of middle on tergites three to six, pygidial plate but little longer than broad, moderately finely, closely punctate.

Length, 6 mm.

Holotype.—Female; El Portal, near Yosemite National Park, California; May 18, 1938; (R. M. Robart, collector); [California Academy of Sciences, No. 4350].

Allotype.—Male; with same data; [California Academy of Sciences, No. 4351].

Paratypes.—Two females; with same data; [Acad. Nat. Sci. Phila. and collection of writer].

Subgenus **MICROPASITES** Linsley

1942. *Micropasites* Linsley, Pan-Pac. Ent., XVIII, p. 130.

Body small, robust; maxillary palpi short, composed of one or two free segments; antennae with first flagellar segment at most slightly longer than pedicel; anterior wings with second submarginal cell as long as first submarginal cell.

TYPE: *Neopasites cressoni* Crawford.

This subgenus contains three known species, distinguishable as follows:

Females

1. Tarsi with only the anterior claws armed with an inner tooth; larger species 4 to 7 mm. 2
   Tarsi with all the claws armed with an inner tooth; flagellum with first segment twice as long as second segment; maxillary palpi with one free segment. 3.5 mm. (Riverside County, California) ..... *timberlakei*
2. Maxillary palpi with one free segment; flagellum with first segment twice as long as second; abdomen black, apical margin of segments testaceous. 4 mm. (Mojave Desert, California) ..... *mojavensis*
   Maxillary palpi with two free segments; flagellum with first segment less than twice as long as second; abdomen with basal segments red. 5 to 6 mm. (Southern California) ..... *cressoni*

Males

1. Tarsi with all of the claws bifid at apex, intermediate claws without a basal tooth; maxillary palpi with one free segment; pygidial plate not longer than basal width, apex more broadly rounded; genitalia with a narrow, pointed spatha, sagittae much longer than spatha. 3.5 mm. (Riverside County, California) ..... *timberlakei*
   Tarsi with only anterior claws bifid at apex, intermediate claws with a basal tooth; maxillary palpi with two free segments; pygidial plate longer than basal width, apex more narrowly rounded; genitalia with a broad, rounded spatha, sagittae shorter than spatha. 4.5 to 6 mm. (Central and southern California) ..... *cressoni*

Gnathopasites (Micropasites) cressoni (Crawford)

1916. *Neopasites cressoni* Crawford, Ins. Insc. Mens., IV, p. 136. ♂.
1942. *Gnathopasites* (*Micropasites*) *cressoni* Linsley, Pan-Pac. Ent., XVIII, p. 130.

Female. Form moderately robust; color black, mandibles, except base and apex, underside of flagellum, pronotal tubercles, tegulae, apex of femora, base and apex of tibiae, abdomen reddish.

Head closely, more or less contiguously punctate, interspaces shining; lower half of face rather densely clothed with white pubescence, vertex with brown pubescence; antennae with first flagellar segment less than twice as long as second; maxillary palpi with two free segments inserted on a tubercle.

Thorax opaque, closely, subcontiguously punctate; mesoscutum irregularly margined with white pubescence, anterior half of median line and parapsidal furrows white-pubescent; mesoscutellum more coarsely punctate than mesoscutum, mid-line and lateral margins white-pubescent; metanotum largely white-pubescent; propodeum densely clothed with white pubescence except triangular area which is dullish, closely, subrugosely punctate.

Wings lightly infuscated except pale areas in vicinity of submarginal and cubital cells.

Legs thinly clothed with white pubescence, only the anterior claws armed with an inner tooth.

Abdomen red, basal concavity, segments three to six, sides of tergites one and two and disk of sternites one and two, fuscous or clouded with fuscous; lateral, sublateral and apical margins of tergites narrowly clothed with white pubescence, expanded in the form of oval white patches on each side of middle of apical margin of tergites three and four.

Length, 5 to 6 mm.

Males. Black, mandibles at middle, pronotal tubercles, tegulae, apex of femora, base and apex of tibiae and narrow apical margin of abdominal tergites reddish; tarsi with only the anterior claws bifid at apex, intermediate claws with an inner basal tooth; pygidial plate elongate triangular, longer than basal width, apex narrowly rounded; genitalia with a broad, apically rounded spatha, sagittae shorter than spatha.

Length, 4.5 to 6 mm.

Type locality.—La Quinta, California.

Additional localities.—All California: Claremont, (Baker), 1 ♀, 2 ♂; Altadena, (Michener), 1 ♂; San Bernardino, (Linsley); Riverside, (Timberlake), 2 ♀, 1 ♂; Gavilan, Riverside County, (Timberlake), 1 ♂; Mount Diablo, (Michener), 1 ♂.

Flight period.—April and May.

Flower records.—*Cryptanthe intermedia* (Timberlake).

Host.—Unknown.

Gnathopasites (Micropasites) timberlakei new species

Distinguished from the other known species by having all of the claws toothed in the female and bifid in the male, as well as by the small size. From *cressoni* it further differs in the one segmented maxillary palpi and form of the spatha and sagittae of the male genitalia.

Female. Small, black, mandibles at middle, pronotal tubercles, tegulae, apex of femora, base and apex of tibiae, and apical margins of abdominal tergites and sternites, testaceous or rufotestaceous.

Head closely punctate, dullish; lower half of face densely clothed with white pubescence, sparser on upper half where it is mixed with brownish on vertex; antennae with first segment of flagellum twice as long as second; maxillary palpi with one free segment inserted on a tubercle.

Thorax closely punctate; mesoscutum margined with white pubescence, closely, subcontiguously punctate, vaguely transversely rugulose when viewed with anterior illumination; mesoscutellum scarcely more coarsely punctate

than mesoscutum, with a patch of white pubescence on posterior margin at middle; metanotum largely white-pubescent; propodeum densely white-pubescent except triangular area which is coarsely punctate, longitudinally rugose.

Wings moderately infuscated, except pale areas in vicinity of submarginal and cubital cells.

Legs clothed with white pubescence; tarsi with an inner tooth on all claws.

Abdomen black, moderately shining but very closely punctate, posterior margins of tergites testaceous; lateral and posterior margins narrowly, sublateral margins broadly, white-pubescent, tergites three and four with a patch of white pubescence on each side of middle.

Length, 3.5 mm.

Male. Black, tegulae piceous; tarsi with all claws bifid at apex, intermediate claws without an inner tooth; pygidial plate at most no longer than basal width, apex broadly rounded, genitalia with a narrow, pointed spatha, sagittae much longer than spatha.

Length, 3.5 mm.

Holotype.—Female, Riverside, California, April 15, 1938; (P. H. Timberlake, collector; flying over ground); [Citrus Experiment Station, Riverside, California].

Allotype.—Male; same data; [C. E. S.].

Gnathopasites (Micropasites) mojavensis new species

Apparently related to *timberlakei* but distinguished by having all of the claws armed with an inner tooth in the female. Differing from *cressoni* in the one segmented maxillary palpi, smaller size, more shining integument, longer first segment of the antennal flagellum and black abdomen (female) with the pale areas of the head, thorax and legs testaceous rather than red.

Female. Small, piceous, mandibles at middle, pronotal tubercles, tegulae, apex of femora, base and apex of tibiae, and apical margins of abdominal tergites and sternites testaceous.

Head closely punctate but interspaces distinctly shining; lower half of face thinly clothed with white pubescence; antennae with first segment of flagellum twice as long as second; maxillary palpi with one free segment inserted on a tubercle.

Thorax feebly shining, closely punctate; mesoscutum subglabrous except for a few white hairs in anterior third of median line and along anterior margin; mesoscutellum scarcely more coarsely punctate than mesoscutum, median line at base, and lateral margins, white-pubescent; metanotum largely white-pubescent; propodeum densely white-pubescent except triangular area which is glabrous, subrugosely punctate.

Wings very lightly infuscated except pale areas in vicinity of submarginal and cubital cells.

Legs thinly clothed with white pubescence; tarsi with only the anterior claws armed with an inner tooth.

Abdomen black, moderately shining, posterior margin of tergites testaceous; lateral and apical margins narrowly, sublateral margin broadly, white pubescent, tergites three and four with an ill-defined apical white patch on each side of middle.

Length, 4 mm.

Holotype.—Female; seven miles north of Llano, California; May 2, 1937; (P. H. Timberlake, collector; flying over ground); [Citrus Experiment Station, Riverside, California].

Rug

THREE NEW SPECIES OF CAPNIA FROM COLORADO

(PLECOPTERA: CAPNIIDAE)

BY T. H. FRISON

Illinois State Natural History Survey, Urbana

(Text-figures)

This paper presents the descriptions of three new species of *Capnia* collected in Colorado immediately preceding and after the North American Wildlife Conference held in Denver in February, 1943. I am indebted to several individuals and organizations for transportation and other assistance in connection with my field trips as follows: To Mr. C. C. Sperry of the U. S. Fish and Wildlife Service and other officials of this Service; to Mr. A. M. Bailey, Director of the Colorado Museum of Natural History, Denver; and to Dr. H. G. Rodeck, Director of the University of Colorado Museum, Boulder.

The drawings are the work of Miss Kathryn M. Sommerman, Entomological Assistant, Illinois State Natural History Survey, and I am appreciative of this assistance.

Capnia wanica new species (Figs. 1*a*–1*c*.)

This new species is quite different from any previously described. In Needham & Claassen's (1925) key to the males of the species of *Capnia* it keys to couplet 6 with the species *fibula* and *elongata.* Both of these species, however, have supra-anal processes much different in shape and the tubercles on the seventh abdominal tergites are much smaller and different in character. In Ricker's (1943) more recent key to the males of *Capnia,* this new species keys to couplet 16, again with the species *fibula* and *elongata,* but as stated before the supra-anal processes of these two species are different. It should be mentioned also that male specimens of

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fibula and *elongata* recorded to date have had long forewings, whereas the forewings in the typic series of this new species are short.

Needham & Claassen (1925) state the female of *elongata* is unknown but describe and partially figure the female of *fibula;* however, not sufficiently to enable me to make a comparison of *fibula* with this new species. Ricker (1943) describes and figures the terminal abdominal sternites of the female of *elongata.* The female of *elongata* as described by Ricker differs markedly from the female of this new species in that the seventh and eighth abdominal sternites in *elongata* are fused.

Male: Body and appendages brown to black. No gill remnants. Head through compound eyes much wider than pronotum; lateral ocelli about three times as far apart as distance from inner margins of compound eyes; median ocellus about as far forward from lateral ocelli as distance between them; maxillary palpi less than thickness of basal flagellar segments.

Pronotum slightly wider than long, with a distinct median longitudinal line or space; embossings present. Wings very short, forewings extending backwards about to posterior margin of thorax and hind wings extending about to posterior margin of first abdominal tergite; hyaline.

Abdomen with first six segments without special structures; seventh tergite with a conspicuous, raised knoblike structure or tubercle in middle on posterior half, figs. 1*a* and 1*b*; eighth tergite with median posterior portion slightly bulging upwards and with a narrow, median, longitudinal, membranous stripe, this stripe continuing on ninth and tenth tergites to base of the supra-anal process, fig. 1*b*; supra-anal process of tenth tergite elongate and tapering to a point, and appearing concave when viewed from the side, curved over apical segments so that its tip reaches about to tubercle on seventh tergite when apical segments are contracted, figs. 1*b* and 1*c*. Ninth sternite without a lobe at base. Cerci long, many segmented, middle and posterior segments becoming two or three times as long as basal segments.

Length of body, 6–7 mm.

Female: Similar in general morphological features to the male. Eighth abdominal sternite, fig. 1*c*, with middle portion largely membranous; without a distinct subgenital plate as in many species of this genus, although posterior margin of the median area in mature specimens is more sclerotized and shows as a crescentric area. A broad, membranous, median stripe extends longitudinally across tergites one through seven and partially on the eighth. Wings long, extending well beyond tip of abdomen; radius of forewing sinuate at origin of radial sector; hyaline.

Holotype.—Male; north of Longmount, Colorado, Little Thompson River; Feb. 19, 1943; mating with allotypic female; (T. H. Frison & H. G. Rodeck).

Allotype.—Female; same data as for holotype.

Paratypes.—All from Colorado; same data as for holotype, including one mating pair, 77 ♂ and 31 ♀; same data as for holotype except Feb. 18, 1943, 4 ♂; Littleton, South Platte River, Feb. 13, 1943, (T. H. Frison & C. C. Sperry), 28 ♂ and 9 ♀; Sedalia, Plum Creek, Feb. 13, 1943, (T. H. Frison & C. C. Sperry), 34 ♂ and 6 ♀, including one mating pair.

Holotype, allotype and most of paratypes in the collection of the Illinois State Natural History Survey, Urbana. Three male and three female paratypes deposited in the collection of the American Entomological Society, Philadelphia.

A series of nymphs of this species were collected at Sedalia, Colorado, Plum Creek, Feb. 13, 1943, in association with paratypic males. The tenth abdominal tergite of mature nymphal males is conical and in some specimens the curved supra-anal processes may be seen clearly. The association of these nymphs with this species is further indicated by the rudimentary wing pads in the nymphal males. The female nymphs are larger than the males and have normal wing pads. In general, the nymphs are very similar to those of other species of *Capnia* and *Allocapnia* and, unfortunately, present knowledge is not sufficient to distinguish them certainly from other closely related species except when definitely associated with adults.

Capnia barbata new species (Figs. *2a–2c.*)

In the keys to males of the genus *Capnia* by Needham & Claassen (1925) and Ricker (1943), this new species will run to the species *decepta, teresa, californica, excavata* and *tumida.* It differs from the males of these species as follows: from *excavata* in lacking a notched tubercle on eighth abdominal tergite; from *teresa* in lacking two distinct granulate tubercles on ninth tergite; from *tumida* in that in *tumida* the swollen portion of the supra-anal process is much broader and the rows of spines are much more developed; from *californica* in lacking two knobs on ninth abdominal tergite; and from *decepta* in shape of supra-anal process and in the tubercle on seventh abdominal tergite that does not extend so far backwards over eighth tergite. Females of *californica* and *teresa* have not been described and the female of *decepta* has been

too poorly described and figured by Needham & Claassen (1925) to permit of a comparison with the female of this new species. The female of *tumida,* as described by Frison (1942), has the seventh and eighth abdominal sternites distinctly fused, which is not the case in this new species. The female of *excavata,* as described by Frison (1937) has a subgenital plate which is different in shape from that of this new species.

Male: Similar in general features to *Capnia wanica* Frison.

Differs from this and other species of this genus as follows: Abdomen, figs. 2*a* and 2*b*, with first six segments without special structures; seventh tergite with a tubercle extending from median posterior part of tergite slightly over anterior part of middle of eighth tergite; eighth and ninth tergites without special structures except that middle area of each has a rounded membranous patch covered in part by tubercle of seventh tergite and supra-anal process; supra-anal process extending but slightly beyond anterior margin of ninth tergite, narrow at base, swollen broadly in middle, a group of short spines on anterior portion of swollen area appearing almost as a single spine when viewed from above, posterior portion of process rapidly reduced in size toward apex and terminating in two short points lying in the same horizontal plane. Wings extending beyond tip of abdomen; radius of forewing sinuate at origin of radial sector; hyaline. Ninth sternite without a lobe at base.

Length of body, 5–6 mm.

Female: Similar in general features to the male. Eighth abdominal sternite, fig. 2*c*, with a well-developed subgenital plate which is heavily sclerotized, shaped as in figure, and not fused with seventh sternite. A broad, membranous, median stripe extends longitudinally across tergites one through eight.

Holotype.—Male; north of Longmount, Colorado, Little Thompson River; Feb. 19, 1943; (T. H. Frison & H. G. Rodeck).

Allotype.—Female; same data as for holotype.

Paratypes.—All from Colorado: same data as for holotype, 1 ♂ and 1 ♀; same data as for holotype except Feb. 18, 1943, 1 ♂ and 1 ♀; Littleton, South Platte River, Feb. 13, 1943, (T. H. Frison & C. C. Sperry), 1 ♂.

Holotype, allotype and paratypes in the collection of the Illinois State Natural History Survey, Urbana.

Capnia limata new species (Figs. 3*a*–3*c*.)

This species belongs to a group of species which, at least in the males, are difficult to define and are characterized by rather inconspicuous differences. It is possible that extensive material from numerous western states will reveal that in some cases subspecific categories are involved.

In the key to males of the genus *Capnia* by Needham & Claassen (1925) the male of this new species will run to couplet 10 containing *glabra* and *vernalis*. In Ricker's (1943) recent key to the males of *Capnia*, this new species will run to couplet 25 leading to the species *glabra, confusa* (*nivalis*), *oenone,* and *projecta.* Hanson (1943) has described three additional species; *ligulata, lineata,* and *zukeli,* which also must be considered, particularly the first two. The species *ligulata* Hanson, described from two male specimens collected in Colorado in March, may be the same as *confusa* Claassen, and I have a series of males and females collected with the other species described as new in this paper which I have tentatively considered as *confusa.*

Aside from the minor differences in the shape of the supra-anal process, which distinguishes this new species in the male from the other species mentioned in the preceding paragraph, the female presents the strongest evidence to support the separate specific status of this new species. Of the various species mentioned, the females of *projecta, oenone, confusa, lineata,* and *zukeli* only have been described and none of these has the conspicuous fusing of the seventh and eighth abdominal sternites which is such a feature of the sternites of this new species.

Male: Similar in general features to *Capnia wanica* Frison.

Differs from this and other species of this genus as follows: Abdomen, figs. 3*a* and 3*b*, without special conspicuous raised tubercles on dorsal tergites; eighth and ninth tergites appear somewhat swollen, particularly when viewed from the side, and there is a median, longitudinal, membranous area on these tergites which tends to be depressed; supra-anal process is long and slender, usually reaching to about middle of eighth tergite, apical third of process tapering rapidly to a point which is slightly recurved downwards at extreme tip. Wings extending beyond tip of abdomen; radius of forewing sinuate at origin of radial sector; hyaline. Ninth sternite without a lobe at base.

Length of body, 5 mm.

Female: Similar in general features to the male. Eighth abdominal sternite, fig. 3*c*, with a subgenital plate shaped as in figure; the seventh and eighth sternites are narrowly but distinctly fused along medial axis. A broad, membranous, median stripe extends longitudinally across tergites one through seven and partly on eighth.

Holotype.—Male; Littleton, Colorado, South Platte River; Feb. 13, 1943; (T. H. Frison & C. C. Sperry).

Allotype.—Female; same data as for holotype.

Paratypes.—All from Colorado: same data as for holotype, 7 ♂ and 5 ♀; Pueblo, Fountain Creek, Feb. 13, 1943, (T. H. Frison & C. C. Sperry), 2 ♂.

Holotype, allotype, and most of the paratypes in the collection of the Illinois State Natural History Survey, Urbana. 1 ♂ and 1 ♀ paratype are placed in the collection of The American Entomological Society.

Although I did not succeed in collecting mating pairs of this species I feel reasonably certain of the association here made. Of the six species of *Capnia* I collected in Colorado in February, 1943, mating pairs were taken of three. Of the other three species, females were taken of two and their association with certain males is based upon an association in time and place with the males in a manner which permitted but one interpretation.

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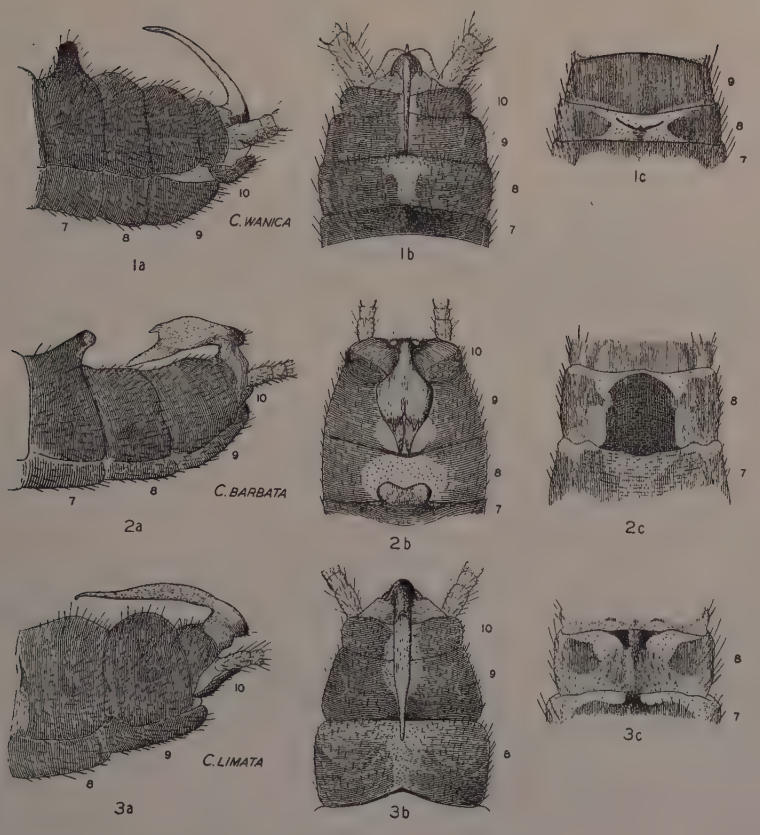

Explanation of Figures

Fig. 1.—*Capnia wanica* new species. 1*a*, male genitalia, lateral view; 1*b*, male genitalia, dorsal view; 1*c*, female abdomen, ventral view.

Fig. 2.—*Capnia barbata* new species. 2*a*, male genitalia, lateral view; 2*b*, male genitalia, dorsal view; 2*c*, female abdomen, ventral view.

Fig. 3.—*Capnia limata* new species. 3*a*, male genitalia, lateral view; 3*b*, male genitalia, dorsal view; 3*c*, female abdomen, ventral view.

CRITICAL NOTES ON AND DESCRIPTIONS OF AMERICAN STEIRODONT KATYDIDS

(ORTHOPTERA, TETTIGONIIDAE, PHANEROPTERINAE)

PART I

BY JAMES A. G. REHN

(Plates XI to XIII)

In the preparation of a number of faunistic studies of tropical American Orthoptera, with which I have been engaged for some years, I have examined extensive series of previously unreported material in the Philadelphia collections. In a number of cases this work has required studies of revisionary character. The results of these revisions I plan to publish from time to time.

Among the large and striking steirodont katydids there was found to be much new or unrecorded information,—in undescribed forms, the amount of individual variation, extension of ranges of previously-known species, and the correction of past taxonomic misinterpretations. The present contribution is the first of a series of this character dealing with the steirodonts.

A Review of the Genus Steirodon of Authors (Phyllolophus new name)

PHYLLOLOPHUS[1] new name

1873. *Steirodon* Stål, Öfv. K. Vetensk. Akad. Förhandl., xxx, no. 4, pp. 40, 42. (Not of Serville, 1831.)

1874. *Steirodon* Stål, Recensio Orthopt., II, pp. 19, 44. (Not of Serville, 1831.)

GENOTYPE: *Steirodon validum* Stål.

As set forth by me in 1905[2] the genus *Steirodon* of Serville[3] was erected on three forms, i.e. *citrifolius, prasinus* and *thoracicus,* the second of which was placed in the genus *Trigonocorypha* in

[1] From *φύλλον, leaf,* and *λόφος, crest,* from the character of the pronotal carinae.

[2] Proc. Acad. Nat. Sci. Phila., 1905, p. 807, footnote 14.

[3] Ann. Sci. Nat., xxii, p. 140, (1831).

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1874, and the third in *Posidippus* the same year, while the first named has been the generally accepted basis of the generic name *Steirodon.* The specific name *citrifolius* was first used by Linnaeus in 1758 as *Gryllus* (*Tettigonia*) *citrifolius,*[4] and subsequently in various generic combinations, but, as shown by the references, with continuity of nomenclatoral intent by Fabricius, DeGeer, Thunberg and subsequent authors.

As has been shown largely by Stål's evidence,[5] drawn from the original material of Linnaeus, DeGeer and Thunberg, these authors had before them individuals representing two, and if Stoll's use of the specific name *citrifolia* is included even three, distinct genera. In 1917 I discussed these associations.[6]

As Stål has shown the specific name *citrifolius* as first used by Linnaeus was applied to a species of the genus *Posidippus* as currently understood, and it is equally evident that Fabricius merely passed on, with a reference to the same, Linnaeus' concept. While DeGeer's understanding of *citrifolius* was based on that of Linnaeus, and his figure and his material show he also had a *Posidippus* before him, Thunberg, on the other hand, quoted merely Fabricius, while the evidence of his material, according to Stål, is conclusive that he had before him a species of the genus to which Stål in 1873 restricted the name *Steirodon,* a limitation which has been followed by subsequent authors.

In my 1905 discussion [7] of the specific elements originally placed in *Steirodon* by Serville [8] I narrowed the generic name down to *citrifolia,* but, following Stål, endeavored to save the generic name in its long accepted application by designating as the type—the first limitation of this kind to be made—"*Phyllophora citrifolia* Thunberg = *Steirodon validum* Stål." This, however, cannot be maintained, as *citrifolius* as used by Serville in 1831 was based chiefly on the original and true *citrifolius,* citing Fabricius and DeGeer, and a genus cannot be maintained on a misidentification even though it remained unrecognized for over forty years. In consequence the restricted type of *Steirodon* must be *Locusta citri-*

[4] Syst. Nat., X ed., p. 429.
[5] See Stål, Recensio Orthopt., II, pp. 44, 45, 46, (1874).
[6] Entom. News, XXVIII, p. 114.
[7] Proc. Acad. Nat. Sci. Phila., 1905, p. 807, footnote 14.
[8] Ann. Sci. Nat., XXII, p. 140 (1831).

folia as understood by Fabricius and DeGeer and, as shown, by Serville, which species according to Stål's evidence from the original material of DeGeer is the true *citrifolius* of Linnaeus, Fabricius having merely passed on the concept of the original describer (i.e. Linnaeus).

As a result *Steirodon* becomes the oldest and hence the proper name for the genus named *Posidippus* by Stål in 1874,[9] which latter falls as a synonym, and the generic entity considered to be *Steirodon* by Stål in 1873, and by all subsequent authors, must be renamed, which has been done above with its genotype indicated, the latter being, from Stål's evidence, the species misidentified by Thunberg as *citrifolia.*

Key to the Species of Phyllolophus

1. Pronotum with lateral crests of the disk proportionately lower, less vertically elevated and more truly oblique or dorso-lateral in their trend; in profile these crests are more obtusely arcuate and hardly obtuse-angulate in outline, highest point more rounded; margins of crests more coarsely dentate.....2

   Pronotum with lateral crests of the disk proportionately higher and more vertically elevated, less oblique or dorso-lateral in their trend; in profile these crests are more definitely obtuse-angulate in outline and less obtusely angulate, highest point more decided; margins of crests more finely dentate.....*validus* (Stål)

2. Dentations of lateral crests of pronotal disk finer, more serrate, less truly dentate, less deeply separated, apices less pronounced acute. Fastigia of both vertex and face broader, less deeply divided medio-longitudinally. Median tibiae with outline more fusiform proximad..*ponderosus* (Stål)

   Dentations of lateral crests of pronotal disk coarser, much more deeply separated and individually more cuspidate. Fastigia of both vertex and face narrower, more definitely divided medio-longitudinally. Median tibiae with outline more sharply expanded proximad.....3

3. Dentations of lateral crests of pronotal disk individually more acute, not as stout. Tegmina with median vein diverging from humeral trunk briefly proximad of proximal third of tegminal length. (Size very large.).....*alfaroi* new species

   Dentations of lateral crests of pronotal disk individually blunter, averaging stouter. Tegmina with median vein diverging from humeral trunk briefly proximad of middle. (Stridulating field of male tegmina definitely larger than in other species of which male has been examined.).....*ganymedes* new species

[9] Recensio Orthopt., II, pp. 20, 45.

Phyllolophus validus (Stål)
(Pl. XI, figs. 3 and 4; pl. XII, figs. 9 and 10.)

1815. *Phyllophora citrifolia* Thunberg, Mém. Acad. Imp. Sci. St. Pétersb., v, p. 286. (Not *Gryllus* (*Tettigonia*) *citrifolius* Linnaeus or *Locusta citrifolia* Fabricius or DeGeer.)

1874. *S*[*teirodon*] *validum* Stål, Recensio Orthopt., II, p. 44. [♀; Unknown locality.]

This species, as I understand it, can be distinguished from the others here included in the genus, by the combination of more vertically directed lateral crests of the pronotum and the relatively finer dentations of the same. In proportion to their height the crests do not splay laterad as much as in *ponderosus,* and the finer character of the dentations alone will at once distinguish *validus* from *alfaroi* and *ganymedes.*

I have seen but three specimens of this species, but these show it varies appreciably in size, and is also well distributed over the Guianas and the Amazon Basin.

Both of the males seen have the metazonal disk broadly fuscous, this running cephalad briefly and diminishingly along the internal face of the crests. The cephalic border of the pronotal disk and the internal face of the crests in their cephalic half are washed irregularly with dilute creamy white in both males, but not in the female. The tegmina in both males have many of the cross nervures and accessory ramuli of these and of the main veins stained with cinnamon-brown, much of the sutural margin also being weakly but rather broadly clouded with the same. The latter suffusion is very faintly intimated in the single female seen.

The dimensions (in millimeters) of the specimens examined are as follows:

	Length of body	Length of pronotum	Greatest width of pronotum (across crests)	Length of tegmen	Greatest width of tegmen	Length of caudal femur
♂, Napo River, Loreto, Peru	33	10.9	10.9	62.5	17.8	30
♂, Nouveau Chantier, French Guiana	40	13	12.5	74	22.2	31.5
♀, Obidos, Brazil	59	16.5	13.8	84	29.3	39.5

Specimens examined: 3; 2♂, 1♀.

FRENCH GUIANA: Nouveau Chantier; I; 1♂; [Hebard Cln.].

BRAZIL: Obidos, State of Pará, 1♀; [A.N.S.P.].

PERU: Napo River, Loreto; (H. S. Parish); 1♂; [A.N.S.P.].

Phyllolophus ponderosus (Stål)
(Pl. XI, figs. 1 and 2; pl. XII, figs. 7 and 8.)

1874. *S[teirodon] ponderosum* Stål, Öfversigt K. Vetenskaps Akad. Förhandl., xxx, no. 4, p. 42. [♀; Brazil.[10].]

Stål's two descriptions of this species are very unsatisfactory and certain of the features used by him to separate it from *validus* do not seem of value. He had, however, only the female sex, and probably but a single specimen of each species. I find nothing of diagnostic value in the relative width of the marginal field of the tegmina to separate *ponderosus* from *validus,* nor in the outline of the sutural margin of the tegmina, as used by Brunner,[11] of any service in distinguishing the two as I understand them. The character of the latter margin is essentially the same in all individuals (21) of the genus which I have seen.

The feature which appears of greatest value in distinguishing *ponderosus* from *validus* is the general direction and shape of the lateral crests of the pronotum. In *ponderosus* they are somewhat lower, diverge more definitely dorso-laterad and less distinctly narrow down the surface of the pronotal disk.

In size the specimens of this species examined are quite uniform, with the exception of one of the males from Villavicencio, Colombia, and that from Nouveau Chantier, French Guiana, both of which are somewhat smaller than the average, and of the female from Santo Domingo de los Colorados, Ecuador, which is somewhat larger. The measurements (in millimeters) of an average male from Fyzabad, Trinidad, both males from Villavicencio, Colombia, a female from Trinidad (without further data) and that from Santo Domingo de los Colorados, are as follows:

	Length of body	Length of pronotum	Greatest width of pronotum (across crests)	Length of tegmen	Greatest width of tegmen	Length of caudal femur
♂, Fyzabad, Trinidad	45.5	13.8	14	76	23.5	34
♂, Villavicencio, Colombia	36.5[12]	13.2	11.8	72	21.5	32.5
♂, Villavicencio, Colombia	44	13.8	13	75.5	22	35
♀, Trinidad	58	17	17	91	32	42

[10] Vide Stål, Recensio Orthopt., II, p. 44, (1874).
[11] Monogr. Phaneropter., pp. 362–363, (1878).

	Length of body	Length of pronotum	Greatest width of pronotum (across crests)	Length of tegmen	Greatest width of tegmen	Length of caudal femur
♀, St. Jean du Maroni, French Guiana ...	55	17.2	16	89	32	40.5
♀, Santo Domingo de los Colorados, Ecuador	52	18	18	93.5	31	42.5

There is an appreciable amount of variation in the exact width across the lateral crests of the pronotum, but this is governed by the exact amount of "splay" of these structures, and seems purely individual.

The single Guianan male examined (Nouveau Chantier) has the metazonal section of the pronotal disk solidly infuscate, all others lacking this. The Caparo, Trinidad female has the crests somewhat infuscate, a condition indicated in no other individual seen.

The present material shows *ponderosus* ranges from western Ecuador (Pacific coastal slope), the upper Orinocan section of Colombia, and the Andean valleys of Peru, eastward at least to Trinidad and French Guiana, and doubtless a distance southward into Brazil. The extent to which the ranges of *P. ponderosus* and *validus* overlap remains to be determined.

Specimens examined: 14; 10♂, 4♀.

TRINIDAD: No further data; 1♂; [A.N.S.P.]: (F. W. Urich); 1♀; [A.N.S.P.]. Fyzabad; VI, 27, VII, 2 and 9, 1929; (N. A. Wood); 5♂; [Hebard Cln. and A.N.S.P.]. Caparo; VIII, 1913; (S. M. Klages); 1♀; [Hebard Cln.].

FRENCH GUIANA: Nouveau Chantier; I; (from Le Moult); 1♂; [Hebard Cln.]. St. Jean du Maroni; 1914; (R. Benoist); 1♀; [Hebard Cln.].

COLOMBIA: Villavicencio, Dept. Meta; (A. Maria); 2♂; [Hebard Cln.].[13]

ECUADOR: Santo Domingo de los Colorados; (F. Campos); 1♀; [A.N.S.P.].

PERU: Leonpampa, 110 kilometers east of Huanuco, Huanuco Prov.; XII, 1937; (Felix Woytkowski; in tropical jungle); 1♂; [A.N.S.P.].

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[12] Abdomen shrivelled.

[13] Reported by Hebard (Trans. Amer. Entom. Soc., LIX, p. 48, (1933) as *Steirodon validum.*

Phyllolophus alfaroi[14] new species
(Pl. XII, figs. 11 and 12; pl. XIII, fig. 13.)

This striking form is, in the female sex, one of the largest of the known phaneropterines. The major features which distinguish it from the other forms of the genus have been given in the preceding key. There should be no confusion with either *P. validus* or *ponderosus,* and from *ganymedes,* its nearest relative, of which the female sex is not known, in addition to the key characters its proportionately longer and narrower tegmina should at once serve to distinguish *alfaroi.*

Type.—♀; Orotina, Province of Alajuela, Costa Rica. October 11, 1913. (Anastasio Alfaro; at light.) [Academy of Natural Sciences of Philadelphia, Type no. 5692.]

Size very large (length of body, 61.5 mm.; length of tegmen, 98); form quite elongate, greatest width across lateral crests of pronotum contained almost seven times in total length to apices of tegmina, greatest breadth of tegmen contained slightly more than 3½ times in the same length dimension, form in other respects as in the other species of genus; surface as is other species.

Head with greatest width across genae immediately ventrad of eyes contained 1½ times in total depth of head; fastigium of vertex with lateral margins straight and subparallel, medio-longitudinal sulcation distinct but not deep; width of fastigium of face at median ocellus somewhat greater than that of vertex, lateral borders arcuate, median sulcation pronounced dorsad of median ocellus; eyes as in same sex of *ponderosus.*

Pronotum with greatest width across lateral crests slightly less than (type) or subequal to (paratypes) the median length of disk, surface of disk as a whole with its impressions and transverse fold as in *P. ponderosus,* but often (paratypes) more deeply sculptured; lateral crests forming a decided obtuse-angulation as seen from dorsum, and almost equally angulate as seen in profile, the vertical axes of the crests diverging dorso-laterad from the plane level of the disk at but slightly more than a 45° angulation, dentations of lateral crests definitely individual, less serrations than in *P. validus* and *ponderosus,* and well divided between the teeth, which are more subtrigonal, those at the highest point of the crests averaging larger than elsewhere; cephalic margin of disk with its concavity showing a very low and broad median subarcuation, caudal margin of disk obtusely arcuate:[15] lateral lobes as in *P. ponderosus.*

[14] In recognition of the life-long studies of my old friend Prof. Anastasio Alfaro, of San José, Costa Rica, whose interest and energy has added so greatly to our knowledge of the natural history of his native land, and who also collected the type specimen of this species.

[15] Rarely, in a single paratype, low arcuate without any tendency toward obtuse-angulation.

Tegmina elongate lanceolate, greatest width (which is slightly distad of proximal fourth) contained slightly more than three times in the tegminal length;[16] outline of margins essentially as in *ponderosus* except that the median concavity of the sutural margin is less strongly indicated although quite definite; median vein diverging from the humeral trunk very briefly proximad of proximal third, or even slightly closer to the tegminal base than in *ponderosus,* other venational features essentially as in latter species; marginal field at broadest point of tegmen comprising half of total tegminal width. Wings reaching to but hardly surpassing apices of tegmina.

Mesosternal and metasternal lobes somewhat narrower and more sharply angulate caudad than in *P. ponderosus.*

Limbs as in *ponderosus* except that the cephalic tibiae are slightly more slender distad, the proximo-dorsal expansion of the median tibiae is more sharply limited distad and in consequence less gradually reducing in height in that direction, proximal expansion of caudal tibiae slightly less elevated than in *ponderosus,* but of similar general outline and character.

Coloration.—Ranging from parrot green to grass green, the type chiefly of the former shade, probably uniform in the living insect, but in dried material the head, pleura, most of the limbs and even certain areas of the tegmina are solidly colored or weakly tinted with raw sienna to zinc orange. Eyes orange rufous to argus brown. Lateral crests of pronotum with the dentations variably washed with brussel brown, their immediate tips usually raw sienna. In dry material the cephalic and median femora are largely hoary bluish white, their respective tibiae almost pale turquoise green. Caudal femora in dry material with external face definitely dappled light and dark.

Measurements (in millimeters)

	Length of body (including ovipositor)	Length of pronotum	Greatest width of pronotum (across crests)	Length of tegmen	Greatest width of tegmen	Length of caudal femur	Length of ovipositor
♀, Orotina, Costa Rica, *type*	61.5	18	16.8	98	30.5	44	8
♀, Costa Rica, *paratype* ..	61	18	18	92	30.5	40.5	7.5
♀, Costa Rica, *paratype* ..	58.5	17.8	18	95	30	43	7.9
♀, "Central America" ..	57	17	17.8	—[17]	29	40.5	8.2

Paratypes.—In addition to the type I have examined two Costa Rican females without exact locality, one taken by C. F. Underwood and in the collection of the Academy, the other from the same collector, dated April 1902, and in the Hebard Collection.

[16] In one paratype this is contained not quite three times.
[17] Alar organs of this individual are badly damaged in distal third.

These specimens I am considering paratypes. The noteworthy features of difference of these specimens from the type have already been touched upon in the preceding description.

Specimens examined: 4; 4♀.

COSTA RICA: Orotina, Province of Alajuela; X, 11, 1913; (A. Alfaro); 1♀ (*type*); [A.N.S.P.]. No exact locality; (C. F. Underwood); 1♀ (*paratype*); [A.N.S.P.]:[18] IV, 1902; (C. F. Underwood); 1♀ (*paratype*); [Hebard Cln.].

"CENTRAL AMERICA": (Rev. T. Heyde); 1♀; [Hebard Cln.].

Phyllolophus ganymedes[19] new species
(Pl. XI, figs. 5 and 6; pl. XIII, fig. 14.)

This most distinctive form can at once be recognized by the characters given in the key, as well as by the proportionately less attenuate tegmina (in the male sex). The large and much more ampliate stridulating field of the male tegmina is very different from that of either *P. validus* or *ponderosus*. The individual dentations of the pronotal crests are larger and more robust proportionately than in any of the other species of the genus, representing, in this respect, very definitely the opposite extreme in the genus from *P. validus*.

Type.—♂; Massive of Tijuca, Organ Mountains, State of Rio de Janeiro, Brazil. Elevation, 500–1900 meters, 1902. (E. R. Wagner.) [Hebard Collection, Type no. 1363.]

Size much as in same sex of *ponderosus;* form appreciably stouter and tegmina shorter and broader than in the other species of the genus of which the male is known, greatest breadth across lateral crests of pronotum contained but slightly more than six times in total length to apices of tegmina, greatest breadth of tegmina contained 3½ times in the same length dimension.

Head much as described for *P. alfaroi;* fastigia as in that species but lateral borders of that of vertex more appreciably diverging proximad and sulcation of both somewhat less decided.

Pronotum much as in *alfaroi,* but with greatest width across lateral crests subequal to median length of disk; lateral crests with their angulation, as seen from dorsum and in profile, more rounded than in *alfaroi,* the degree of lateral divergence of the crests, as seen in cephalic aspect, as in *alfaroi,* dentations of the crests individually larger, thicker and blunter than in *alfaroi,* as in latter those at highest point of crests average larger than elsewhere; cephalic and caudal margins of disk as in *alfaroi:* lateral lobes slightly broader ventrad than in *alfaroi.*

[18] Recorded as *Steirodon validum* by Rehn, Proc. Acad. Nat. Sci. Phila., 1905, p. 807 (1906).

[19] Son of the Trojan king Tros, and cup-bearer to the Greek gods.

Tegmina broad lanceolate, greatest width contained slightly more than three times in the tegminal length, in outline less attenuate distad than in *P. alfaroi;* costal margin more definitely arcuate than in *P. alfaroi,* particularly distad, apex somewhat sharper acute than in that species, sutural margin with convexity at distal fourth more pronounced than in *alfaroi;* median vein diverging from humeral trunk very briefly proximad of middle of tegmen, much distad of where it diverges in *alfaroi;* marginal field at broadest point equal to slightly less than half of greatest tegminal width; stridulating field in length equal to 2/7 of total tegminal length, as against little more than 1/5 in *ponderosus,* breadth of field equal to almost 4/5 the area between pronotal crests, as against hardly more than 1/2 the same in *ponderosus,* free margin of stridulating field much more broadly arcuate than in *ponderosus,* stridulating vein longer, more regular, and more even in width than in *ponderosus,* and not widening distad or impressed as in that species. Wings very slightly surpassing apices of tegmina.

Mesosternal and metasternal lobes essentially as in the male sex of *ponderosus.* Terminal abdominal appendages as in male of *ponderosus.*

Limbs essentially as in *P. alfaroi* except that the median tibiae have the proximal dilation proportionately higher and less gradually diminishing proximad and distad, more emphasized on cephalic than on caudal border and with both borders of the dilation less definitely spined.

Coloration.—In life probably uniform parrot green, which in the dried specimen is largely replaced by light to dull cadmium, the original color preserved on parts of the tegmina. Eyes raw sienna. Lateral crests of pronotum on dorsal (internal) face washed with olive, the tips of the dentations paling to honey yellow. Limbs with some irregular touches of hoary whitish.

Measurements.—Length of body, 41 mm.; length of pronotum, 13; greatest width of pronotum (across crests), 13.5; length of tegmen, 70; greatest width of tegmen, 22.2; length of caudal femur, 34.

Remarks.—I have seen only the type of this species, which is from the most southern exact locality from which the genus is known. Very probably this species is limited in distribution to portions of southern Brazil.

Explanation of Figures

(All natural size)

PLATE XI

Fig. 1.—*Phyllolophus ponderosus* (Stål). Dorsal view of male. Fyzabad, Trinidad.

Fig. 2.—*Phyllolophus ponderosus* (Stål). Cephalic aspect of male. Fyzabad, Trinidad.

Fig. 3.—*Phyllolophus validus* (Stål). Dorsal view of male. Nouveau Chantier, French Guiana.

Fig. 4.—*Phyllolophus validus* (Stål). Cephalic aspect of male. Nouveau Chantier, French Guiana.

Fig. 5.—*Phyllolophus ganymedes* new species. Dorsal view of male (type). Massive of Tijuca, Organ Mts., Brazil.

Fig. 6.—*Phyllolophus ganymedes* new species. Cephalic aspect of male (type). Massive of Tijuca, Organ Mts., Brazil.

PLATE XII

Fig. 7.—*Phyllolophus ponderosus* (Stål). Dorsal view of female. St. Jean du Maroni, French Guiana.

Fig. 8.—*Phyllolophus ponderosus* (Stål). Cephalic aspect of female. St. Jean du Maroni, French Guiana.

Fig. 9.—*Phyllolophus validus* (Stål). Dorsal view of female. Obidos, Brazil.

Fig. 10.—*Phyllolophus validus* (Stål). Cephalic aspect of female. Obidos, Brazil.

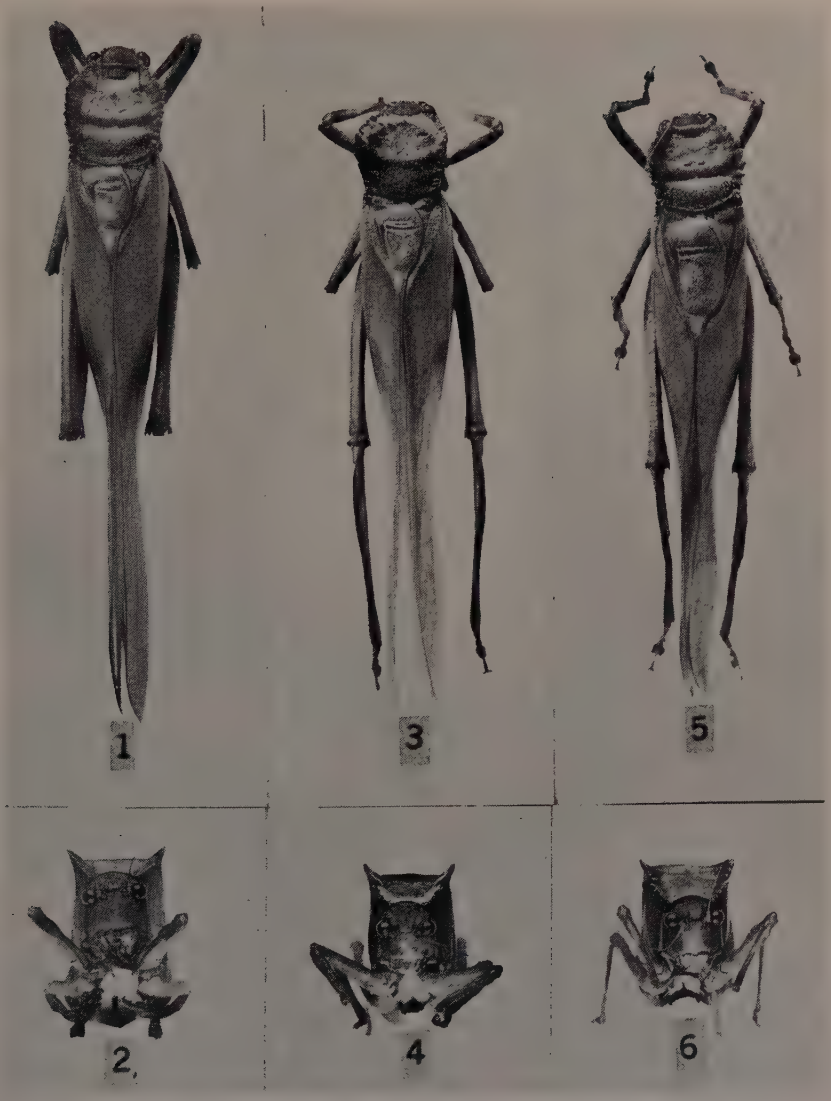
Fig. 11.—*Phyllolophus alfaroi* new species. Dorsal view of female (type). Orotina, Costa Rica.

Fig. 12.—*Phyllolophus alfaroi* new species. Cephalic aspect of female (type). Orotina, Costa Rica.

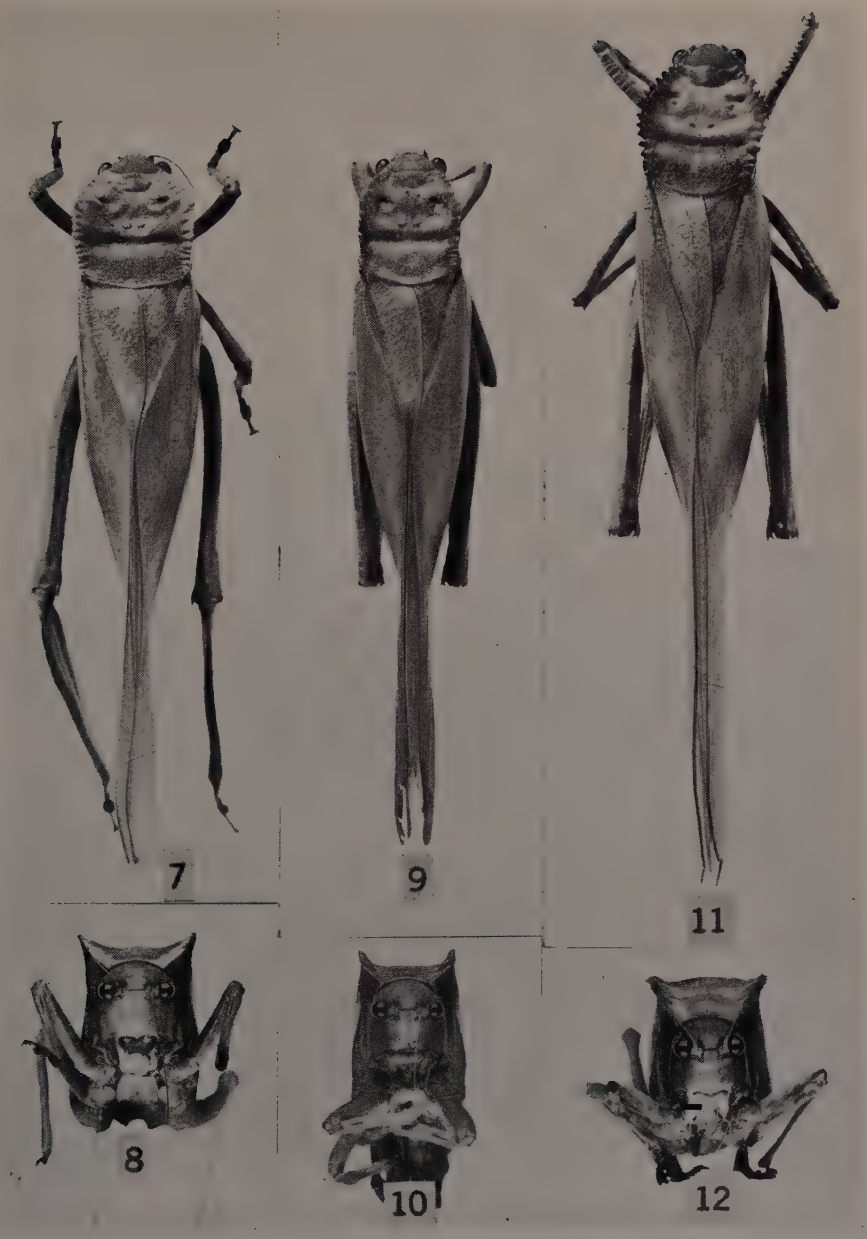
PLATE XIII

Fig. 13.—*Phyllolophus alfaroi* new species. Lateral view of female (type). Orotina, Costa Rica.

Fig. 14.—*Phyllolophus ganymedes* new species. Lateral view of male (type). Massive of Tijuca, Organ Mts., Brazil.



REHN—THE GENUS PHYLLOLOPHUS



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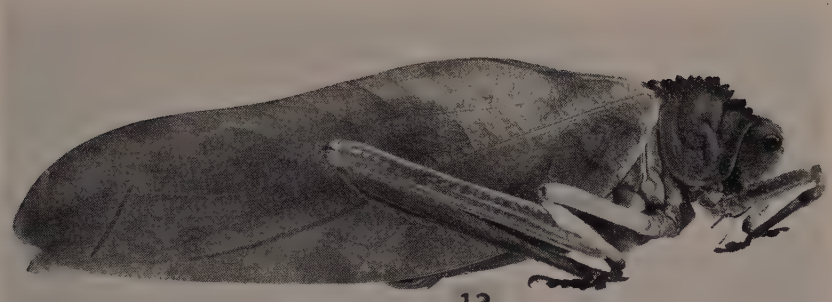

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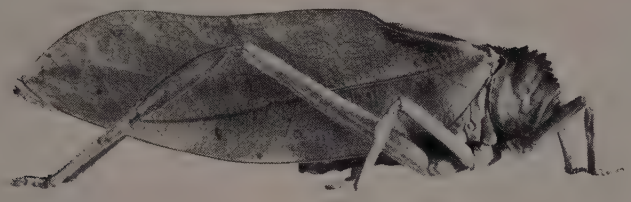

14

FURTHER STUDIES ON NEOTROPICAL GOMPHINE DRAGONFLIES[1]

(ODONATA)

BY JAMES G. NEEDHAM

Cornell University, Ithaca, N. Y.

(Plates XIV to XVI)

This paper is based on materials collected by Dr. D. C. Geijskes in Surinam. Only one Gomphine, *Cacus mungo* Needham, appears to have been reported from that country hitherto.

Our catalogs include no species from Surinam, and only a few from the Guianas on either side—the few, from localities in British Guiana. Dr. Geijskes' field work has disclosed a fauna that is rich in both genera and species. Furthermore, he has collected both immature and adult stages, thus making a very substantial contribution to the knowledge of this little known group.

In the following pages I present at his request descriptions and figures of this new material under the following names:

Archaeogomphus nanus new species.
Agriogomphus sylvicola Selys. Nymph.
Cyanogomphus spp?
Ebegomphus strumens new genus and species.
Cacus mungo Needham. Nymph.
Aphylla cornutifrons new species.
Aphylla producta Selys? Nymph.
Gomphoides fuliginosus Selys. Nymph.
Gomphoides undulatus new species.
Gomphoides cristatus new species.
Cyclophylla signata Selys.
Cyclophylla pachystyla new species.
Cyclophylla sp? No. 7, nymph.
Progomphus brachycnemis new species.
Progomphus geyskesi new species. Nymph.
Progomphus sp? N. 15, nymph.
Desmogomphus tigrivensis Williamson.
Mitragomphus ganzanus new genus and species.
Zonophora calippus Selys.
Zonophora surinamensis new species.
Zonophore sp? Nymph.

[1] The preceding study of this series was published in these Transactions, LXX, pp. 363–394, pls. 20 to 22, 1940.

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Issued March 13, 1944 1116.100

The nymphal material of the above list has enabled me to prepare a first key to the nymphs of the genera of Neotropical Gomphines. It is, of course, provisional; for it is based on generic determinations that are not in all cases positive. Some have been determined by actual rearing to the adult stage, in Surinam and, earlier, elsewhere; a few, by the study of the venation of the developing nymphal wings; a few, by source and associated adults at large.

VERIFICATION TABLE

	1	2 Labial		3 L. of segments*			4 5 On segments		6 L. of app.*		
GENERA	Length	hk.	tth.	9	10	app.	d.h.	l.sp.	lat.	sup.	inf.
Agriogomphus	15	+	0	10	6	9	3–9	3–9	8	9	10
Aphylla	41–68	+	+	10	50	5	3–5	0	10	10	10
Archaeogomphus	16	+	0	10	9	8	4–9	7–9	8	10	10
Cacus	24	+	0	10	9	10	2–9	4–9	7	9	10
Cyanogomphus	17–21	+	0	10	7	8	5–9	3–9	8	9	10
Cyclophylla	25–40	+	0	10	35	7	5–9	5–9	10	10	10
Desmogomphus	27	+	+	10	9	14	2–9	7–9	9	10	10
Ebegomphus	20	+	0	10	9	11	4–9	3–9	6	7	10
Epigomphus	27	±	±	10	9	9	0	7–9	10	10	10
Erpetogomphus	25	±	±	10	8	12	3–9	6–9	10	10	10
Gomphoides	26–42	+	+	10	11	9	2–9	5–9	10	10	10
Neogomphus	24	±	+	10	6	11	0	7–9	5	9	10
Progomphus	16–28	0	0	10	9	10+	1–9	4–9		var.	10
Zonophora	41	+	+	10	7	25	0	8–9	8	10	10

SIGNS USED IN THE TABLE: +, means present; 0, means absent; ±, means more or less undeveloped; var. means varying greatly.

For ease of reference the abbreviated multiple column-headings are to be taken as follows:

1. Length in millimeters when full grown.
2. Presence or absence of { a hook at the end of the lateral labial lobe. / teeth on its inner margin.
3. Relative middorsal length of abdominal segments 9 and 10, and of the longest of the caudal appendages, segment 9 being taken as a standard for comparison of length.
4. Hooks (of whatever form) on middorsal line of abdominal segments.
5. Lateral spines on the same.
6. Relative mature length of the caudal appendages, laterals, superior and inferiors in order, the last being taken as the standard for comparison.

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* These relative lengths are based on crude estimates, and are not even good averages; specific differences are often very great, but within a species, lengths are rather constant.

The key is based on very little material. Therefore I know that it will have to be modified in future years as new discoveries are made, and new diversities encountered. However it may serve for a time as an aid to further research in the field. The verification table will probably be of more permanent value.

The names of three Neotropical genera will not be found in the key: *Diaphlebia* Selys and *Ischnogomphus* Williamson from Colombia, and *Ammogomphus* Foerster from Paraguay; their nymphs are still unknown.

A Key to the Genera of Neotropical Gomphine Drangonfly Nymphs

1. Tarsi 2–2–2-jointed; labium spoon shaped, its lateral lobes wide to the end and concave; slender and delicate; length 15 mm. ... *Archaeogomphus*
   Tarsi 2–2–3-jointed; labium flat; body stouter, total length 20 mm. or more ... 2
2. Wing cases laid parallel along the back[2] ... 3
   Wing cases divergent to rearward ... 12
3. Abdominal segment 10 not more than twice as long as 9 ... 4
   Abdominal segment 10 more than twice as long as 9 ... 11
4. Dorsal hooks present on some of the abdominal segments ... 5
   No dorsal hooks present ... 9
5. Abdomen broad; no burrowing hook at end of the front tibiae, and no teeth on the inner margin of the lateral lobe of the labium (except in *Cacus,* which has the end of the lateral lobe bluntly rounded) ... 6
   Abdomen long; hook and teeth present ... *Gomphoides*
6. Lateral spines of the 7th abdominal segment excessively large and keeled on the upper side; 10th segment wholly enclosed at the sides by the prolongation of the 9th ... *Cacus*
   Lateral spines of 7 not longer than some that precede; sides of 10 partly exposed ... 7
7. Abdomen excessively flat, as wide as long ... *Ebegomphus*
   Abdomen less depressed, longer than wide ... 8
8. Dorsal hook longest on the 9th segment[3] ... *Cyanogomphus*
   Dorsal hook of the 9 not longer than some that precede it ... *Agriogomphus*
9. Lateral spines present on segments 8 and 9 only; median lobe of the labium squarely truncate in front ... *Zonophora*
   Lateral spines present on at least one additional segment; median labial lobe convex in front ... 10
10. Mentum of labium about as long as wide ... *Epigomphus*
    Mentum of labium much longer than wide ... *Neogomphus*

[2] This will not apply to exuviae with wing cases that remain apart after transformation.

[3] See also the description that follows (p. 184) of an unknown nymph, doubtfully referred to *Cyanogomphus,* that will not conform, but that will be readily distinguished by the upturned tips of its inferior caudal appendages.

11. Lateral spines wanting; convexity of median labial lobe low; teeth before end hook on inner margin of the lateral labial lobe several, very long and saber-form.....*Aphylla*
Lateral spines present; convexity of median labial lobe approaching semicircular form; teeth generally wanting, low, if present....*Cyclophylla*
12. Coxae of middle legs contiguous or nearly so; mentum of labium narrow.....*Progomphus*
Coxae of middle legs wide apart; mentum wide.....*Erpetogomphus*

The Gomphine fauna of Surinam includes some of the most primitive of living Odonata, as well as some of the most peculiar lines of both nymphal and adult specialization. Primitiveness is manifest in the relative inconstancy of venational characters, that elsewhere in the order have become more stable. A well known example is found in the much noted crossveins in and about the wing triangles. In general it may be said that as crossveins become fewer they become more stable; that is true if at the same time they become stronger. As reduction in number proceeds, and the vein building material becomes better distributed for the support of the wing membrane, some crossveins disappear and others become more fixed in place. This clearing out proceeds from the wing base outward and about the stronger parts of the framework of the wing.

There is one place in the Gomphine wing in which I have recently noticed a degree of constancy in crossveins that will justify much more attention than has hitherto been paid to it in systematic work. It is the line of cells extending from the base outward to the triangle along the posterior side of the anal vein. In the hind wing these cells support the broad planing surface of the expanded anal area. Since I want to refer to them frequently in the descriptions which follow, and need a name for them, I propose to call them the cells of the PARANAL row, or more simply, PARANAL CELLS. These meet at the triangle that other row of cells running thence rearward to the wing margin that Williamson called POSTANAL CELLS. (See Pl. XVI, fig. 4*e*.)

A New Species of Archaeogomphus

When in 1917 E. B. Williamson collected his first male specimen of *Archaeogomphus hamatus* in Colombia, he saw at a glance that he had in his hands a most extraordinary dragonfly, and in some respects a very primitive one. He immediately set about collecting a goodly series of specimens, and by diligence obtained thirteen male and nine female adult specimens. On these he based a very detailed description of the species, with adequate illustrations. He first [4] referred it to the genus *Agriogomphus,* being misled by two figures of wing venation, both of which had been published with the label *"Agriogomphus sp?"* Both were misdeterminations; one had been published by myself, and the other by Dr. F. Ris. Each of us had had available a single incomplete specimen. No figures of the venation of the true *Agriogomphus* had yet appeared.

My lone specimen was a fragment of a very teneral male that had come to me, rolled up in a dried ball. It was scarcely recognizable, even as a dragnofly, until I had boiled and unrolled it. It lacked parts of the head, and the generically distinctive end segments of the abdomen were immature. Venation, however, was very clearly shown. It was collected somewhere in the region about Sao Paulo, Brazil, by Dr. Adolph Hempel sometime before 1890. When Williamson was studying his catch he wrote me for a loan of the specimen, and all I could find to send him was a dry slide-mount of the wings.[5] Recently, while clearing out an old cabinet, I discovered among a lot of discarded slides, two balsam-mounts of other parts of that specimen in a sad state of disarray, but with a few critical parts that had become chitinized, available for comparison: leg spines, tips of mouthparts, tips of posterior hamules, and the more solid appurtenances of the penis. On comparing the fragments of the genitalia of the second abdominal segment with Williamson's figures,[6] I find them agreeing in all essential respects with *Archaeogomphus hamatus* Williamson; so now my fragment of a specimen has a name.

[4] Occ. Pap. Mus. Zool. Univ. Mich., no. 59, p. 4, pls. 1 and 2, 1918.
[5] See his paper of 1918,[4] footnote on page 1.
[6] Occ. Pap. Mus. Zool. Univ. Mich., no. 63, pl. 1, fig. 2, 1919.

Doctor Ris' single specimen was a female from Missiones, Argentina, of somewhat larger size (abdomen 25 mm.; hind wing 21.5). In 1909 he published a figure of the venation in his Libellulinae of the de Selys Collection, "als Paradigma einer sehr primativ Aderung" (p. 10). Then in 1913 [7] he described and named the species *Agriogomphus infans,* n. sp., with a figure of the color pattern of the front of the synthorax.

Williamson, after obtaining a photograph of the type specimen of *Agriogomphus* for study, found that his *hamatus* was generically different in kind, and in 1919 he erected a new genus, *Archaeogomphus,* to contain it. A single female of another Colombian species he refrained from naming for lack of the male. In 1923 [8] he described another species from Venezuela: *Archaeogomphus furcatus,* and with it associated the Colombian female. Now Dr. Geijskes has collected another new species in Surinam, and has generously turned over the specimens to me for description herewith.

Archaeogomphus nanus new species (Pl. XIV, figs. 1*a*–1*g*.)

This species differs from *hamatus* and *furcatus* in coloration, lacking both the greenish overcast and the pattern of that species. The posterior hamule of the male is more slender, and the peduncle ("vesicle") of the penis when viewed from the rear shows a much wider cleft than in either of those species. The hook of the posterior hamule is much deeper than in *hamatus* and smooth on its inner margin, and the cornua of the penis tip are only about half as long. In the female the top of the occiput is smooth, lacking any projecting angles whatever. In venation *nanus* differs markedly from *hamatus* in that the anal angle of the male hind wing is much lower; in fact, it is hardly angulate at all.

Such comparison with *A. infans,* as may be made with Ris' figures of the female, seem to show more agreement in the smooth occipital margin, in the number of antenodal crossveins and in the possession of an extra cell at the beginning of the row beyond the triangle in the hind wing. But the size is somewhat smaller, and the stripings on the thorax of that species are wanting.

Length 30 mm.; abdomen 22; hind wing 16.

[7] Mem. Soc. Ent. Belg., XXII, p. 72, 1913.
[8] Occ. Pap. Mus. Zool. Univ. Mich., no. 134, pp. 2–9, 3 figs., 1923.

Male. Colors fawn yellow and blackish, without greenish overcast. Face brownish with tints of amber. Labrum and clypeus with paler lower margins; but otherwise unmarked; the border of the labrum fringed with short tawny bristles. Frons above pale in front, with an obscure, straight-edged, dark band covering the basal half. Vertex brown. Occiput brown, concave to rearward, rounded on the edge, somewhat saddleshaped and nearly bare.

Prothorax pale, darker dorsally, yellowish on extreme front and rear margins of the dorsum. Synthorax of a tawny yellow ground color, overspread by chocolate brown, with only a suggestion of a suffused darker stripe on either side of the brown carina. Front all brown; sides fenestrate with brown in and conjoining the sutures. Legs yellow and brown, darker on the dorsal side of the cylindric, short-spined, femora. On the tibiae there is a line of black wherein are set the much fewer and longer, close-ranked, spines. The longer of these spines are near the proximal end of the tibiae, and there are but three (occasionally two or four) on the inner edge of the front tibiae before the tibial comb that completes the row. The second joint of the tarsus is mainly yellow. The arrangement of fine hairs along the sides of the tapered femora and the many spines underneath are quite as described for *A. hamatus* by Williamson, and in general probably are generic characters.

The wings are hyaline, very lightly tinged with yellow over the basal fourth, with dark brown stigma and light brown veins. Ante- and postnodal crossveins in the male are 11:6/9:5 or 6, and in the female there is one additional postnodal. The triangle of the fore wing is in both sexes four-sided; in the hind wing, less so, or not at all, or even briefly stalked on vein M4. In the hind wing the gaff (fused portion of Cu2 and A1 veins) is about as long as the inner side of the triangle. There are two postanal and five paranal cells. Three of the paranal cells are very large and all lie directly behind and in contact with the hind margin of the subtriangle. Veins Cu1 and Cu2 converge toward the outer wing margin and veins A2 and A3 are undifferentiated.

The abdomen is slender and parallel-sided in its middle portion, with the three segments at each end forming together there a spindle-shaped dilation that doubles its diameter. In coloration the abdomen is tawny, rather conspicuously ringed with black. The rings cover the joinings of the middle segments, with an additional narrower ring just before the middle of each. Segments 1 and 2 are mostly pale, darker on the dorsum, but without distinct pattern. Segment 7 lacks the middle ring and is mostly yellow. Segments 8 to 10 are reddish brown, with black edgings to the apical margins of the segments. The expanded edges of the side margins of 8 and 9 are prolonged a little to rearward, twice as large in 8 as in 9, and in both inflexed against the sterna of these segments. On the segment 1 there is a mid-ventral welt-like crossfold (not a tubercle), beset on its most prominent middle portion with a few stiff tawny hairs of very unequal length. There is no special development of the anterior lamina. The anterior hamule is small, obliquely oval, almost bulbous in form, pale in color and lacking hooks or

teeth, but with a little tuft of tawny hairs on the inner side just before its tip. The large posterior hamule is strongly hooked. It is parallel-sided in its lower half and bears a row of stiff bristles on each edge. Its bare upper half tapers into a brown hook whose inner curvature is about a semicircle. The penduncle of the penis is deeply divided by an acute median notch into two converging truncated halves that together inclose the tip of the folded penis. The third segment of the latter bears a pair of lash-like cornua, and before the webbed base of these there are two pairs of minute appendages, one chitinized and the other not.

On the base of the dorsum of 10 are the two big hooks that are characteristic of and peculiar to this genus, each with its blunt tip directed posteriorly. There is a low, rounded, mound-like middorsal tubercle midway between their bases. Segment 10 is about twice as long on the dorsal as on the ventral side, prolonged to rearward in a roof-like triangular extension that overarches the caudal appendages and extends its tip beyond them. The side margins of this extension are denticulate; its blunt tip is a bit dilated, with down-rolled, minutely serrated edges. The dorsum of segment 9 ends in an escarpment-like declivity, in the vertical face of which are two shallow depressions that seem adapted to receive the big hooks of 10, when 9 and 10 are telescoped together.

Looking down on these end segments from above it will be seen that the long outdrawn apex of 10 corresponds to the portion of 9 lying between the two depressions; it looks as if when 10 was stretched so far to rearward, a break occurred in the row of marginal denticles, leaving a bare unarmed edge midway each side, and the denticles of the apical part, inrolled underneath the apex of 10.[9]

The superior appendages of the male are greatly reduced; they reach out rearward to the level of these downturned denticles. They are flattened, lance-oval in outline, not forcipate at all, emarginate on the upper inner margin near the apex, and chitinized narrowly there, and they end in a minute tooth. The inferior appendage is vestigial, hardly more than the primeval supra-anal plate, bulging a little and densely hairy.

The relative lengths of the last four abdominal segments are about as 22:14:10:14 (the last, dorsal length 7 on the ventral side), with the superior appendages, 7 on the same scale.

Female. Measurements, as in the male, but with the body a little stouter, especially the abdomen, whose middle segments are less slender, and whose end segments are less enlarged. Coloration, yellowish brown or fawn and black, with no greenish overcast. Face brown tinted with amber, paler around the lower margins of the clypeus and labrum; the latter bearing a

[9] As to how these peculiar parts at the end of the abdomen may function in copulation, Williamson made one guess (Occ. Pap. Mus. Zool. Univ. Mich., no. 59, p. 15, 1918) and Walker another, both being doubtful. I venture still another guess, equally so. I guess that the big hooks on the dorsum of the tenth segment are functionless or merely decorative; and that the convergent denticulated margins of the prolongation of segment ten above, and the tip of the superior appendages beneath, between them grasp the head of the female in the usual Anisopterous fashion. These guesses all alike await further observation in the field.

sparse stiff fringe of bristles. Vertex and occiput uniformly brown without ridge or angulation. Together with the thickened ridges behind the eyes they form a sort of saddle-shaped depression. There is a whitish ring about the base of each antenna, with a streak of the same color extending therefrom toward the middle ocellus.

Prothorax obscure brownish with front margin narrowly, and rear lobe broadly yellow. There is a deep dark cross sulcus between front and middle lobes, behind which the latter rises steeply and then flattens off to its rearward meeting with the broad hinder lobe, the whole flattish expanse thus formed being yellowish. The spines of the femora are much larger than in the male, the fringing hairs along the sides of same more sparse. On the inner edge of the front tibia there are normally four long spines preceding the comb, with a shorter stouter terminal one projecting beyond the comb. The subgenital plate is developed as a pair of long, close-laid, appressed parallel points similar to those of *A. hamatus* Williamson but longer, extending to rearward as far as the middle of segment 10.

Holotype.—Male; Upper Litani River Surinam; 18″ VII 1939; (Dr. D. C. Geijskes). Now in the Cornell University Collection.

Allotype.—Female; Litani River Surinam near Feti Creek; 8″ VIII, 1939; (same collector). In the Cornell University Collection.

Paratype.—1 ♂; Litani River near Loë Creek, Surinam; 9 XI, 1940; (Schmidt, collector). Returned to Dr. Geijskes.

The venational characters of the wings of *Archaeogomphus* appear to be: lack of a basal subcostal crossvein; arculus situated at or beyond the second antenodal crossvein; stigma weakly braced, and only two other crossveins behind it; vein M2 arising half a cell-width beyond the nodus; middle fork askew forward; generally four-sided triangles, with variable position of the crossvein forming the front border (Williamson gives details of this in *A. hamatus*.[10] There is also generally a tendency for the antenodal crossveins to be matched in position across subcosta, suggesting the condition found in certain primitive Libellulinae. The anal crossing is distant from the subtriangle in the hind wing by four or five times its own length.

In my Neotropical Gomphine paper [11] I described a nymph (out of Dr. Calvert's collection) from Brazil that I said should belong to one of the two known regional genera having but a single row of cells beyond the triangle of the wings; and I guessed that it

[10] Occ. Pap. Mus. Zool. Univ. Mich., no. 59, p. 10, 1918.
[11] Trans. Amer. Ent. Soc., LXV, pp. 386–387, 1940.

belonged to *Archaeogomphus*. That proved to be a good guess. At least, the nymph of *Agriogomphus* is different, as a reared specimen, now at hand, abundantly shows. It differs also by such characters as ally it with *Cyanogomphus* rather closely, and it thus confirms Williamson's judgment as to affinities, based on his study of the adults.

The Agriogomphus Complex

We come now to a peculiar group of inconspicuous and rare little Neotropical Gomphines that fall within the Epigomphus Series proposed by Williamson in his excellent paper of 1920.[12] The group comprises four genera: *Agriogomphus* Selys, *Ischnogomphus* Wmsn., *Cyanogomphus* Selys, and *Strumagomphus* gen. n., hereinafter described. These agree and appear to be more or less peculiar in the following combination of characters:

Their color scheme is done in greens and browns, rather than in the usual Gomphine pattern of yellows and black. In the venation of the wings, the triangle of the fore wing is small and open and nearly or quite equilateral, that of the hind wing is a little longer in the axis of the wing; the anal crossing is remote from the arculus; the middle fork is askew forward; there is no anal loop; the hind wing is narrow at the base; the branches of the anal vein are little developed; and there is a marked enlargement of the third paranal cell and of certain cells beyond it outward along vein Cu2. The tibiae are in cross section sharply quadrangular, and not convex on their outer face. The 10th abdominal segment in the male is prolonged middorsally and excavated below, forming a re-entrant angle from which the copulatory appendages spring.

Knowledge of the nymphs of three of these genera adds evidence of their close kinship. Nymphs of two of these will be described for the first time in the following pages, and a third (*Cyanogomphus*) I described and illustrated in my paper of 1940.[13] The three agree in strongly depressed form of body; blunt-tipped abdomen, armed with high dorsal hooks and stout lateral spines of similar pattern on segments 3 to 9; flattened femora, and tibiae that lack burrowing hooks; slender and pale tarsi; slender antennae with clavate third segment and vestigial

[12] Occ. Pap. Mus. Zool. Univ. Mich., no. 80, p. 8, 1920.
[13] Trans. Amer. Ent. Soc. LXV, p. 382, figs. 27–29, 1940.

fourth segment; short and wide labium with convex middle lobe, stout lateral lobes, long bare end hooks with no teeth on their inner margin. These characteristics become progressively stronger in *Agriogomphus, Cyanogomphus* and *Strumagomphus,* and correspond, I think, to the specialization by reduction and by readjustment seen in the wing venation of the adults.

The species are known from single and often imperfect specimens. Even yet the materials are very scanty; and many of the statements concerning them hereinafter made will have to be taken with due allowance for individual variation. Only the female is known for the genus *Agriogomphus,* but now we have its nymph, and a reared specimen.

Agriogomphus sylvicola Selys (Pl. XIV, figs. 2*a* and 2*b*.)

This primitive little Gomphine, known hitherto from the two adult female specimens that served de Selys for the original description of the species, Dr. Geijskes has reared in Surinam. The nymph, collected on the 4th of November 1942 and caged, transformed to the adult on the 28th of the same month. I have the specimens, adult female and the exuvia from which it came, kindly sent me by Dr. Geijskes for description. The locality data are as follows: "Surinam River, Sectio 0, small creek in bush; nymph resting between dead leaves." The specimens are now in the Cornell University Collection.

Dr. Ris obtained for E. B. Williamson a photograph of one of de Selys' specimens, and Williamson published it as fig. 1 of plate I of his *Archaeogomphus* paper of 1919.[6] In this figure the venation is well shown. I add a few descriptive notes supplemental to de Selys' very brief original description.

This reared specimen measures in length 36 mm.; abdomen 26; hind wing 22. Unfortunately, the color pattern is not fully developed, but it is entirely lacking in the usual Gomphine stripings of black and yellow. It is mostly pale greyish with an undertone of purple. The skin is nearly destitute of hairs, but there is a fringe of stout hairs about the free border of the labrum and on the tips of the lower mouth-parts. The occiput is low and obtuse, and more or less pubescent, but without a distinct erect hair fringe.

The femora are slender, sub-cylindric, tapering toward the knees, brown above but besprinkled with a number of little pale dots; pale underneath where thickly beset with short, sharp, scattered spinules, only the outer row of which shows a tendency toward alignment, with the last spine a little larger than the others. The tibiae are pale externally, distinctly four-ridged, the upper ridges minutely spinulose-serrate, the lower ridges each armed with ten or more blackish spines that are longer than the intervals between them. The tarsi are pale, with short sharp black spines and a single black apical dot on each segment; claws with black tips.

The wings are hyaline with brown veins. The triangle of the fore wings is small, equilateral and straight on the outer side. The front side is slightly broken near the outer end—unequally so in right and left fore wings. The proximal side of the triangle of the hind wings is a little shorter than the other sides. It also is very slightly four-sided in the left wing, not at all in the right. Beyond the triangle there is an added cell at the beginning of the single row. The intermedian crossveins are 4/3 in fore and hind wing respectively. There are two paranal cells distinctly larger than the others, and farther out in the wing the cells on both sides of vein Cu2 are larger than surrounding cells. There is an extra cubito-anal crossvein in the forewing of one side only. The nodal crossveins are 12:8/9:8 in fore and hind wing respectively, with the first and fifth thickened. In the forewing vein Cu1 and Cu2 are strongly convergent to the wing margin.

The abdomen is slender, not at all enlarged at the ends but very slightly tapering all the way to rearward. It is brown on the dorsum, with a band of large quadrangular pale spots each side. These spots are diffuse on segments 1 and 2; they cover the basal half on 3 to 7, reaching backward on all but 7 to the vertical groove that lies obliquely across the middle area; widening to rearward on successive segments until confluent in a crossband on 7. The relative length of the last five abdominal segments is as 40:34:17:10:6, with the appendages 7 on the same scale. Segments 8 to 10 are wholly blackish, and the apical transverse carina is black on all the segments. The slender conical appendages are wholly pale.[14] The subgenital plate is deeply divided by a U-

[14] I am quite unable to interpret or confirm de Selys' statement concerning the caudal appendages: "couchès sur un protubèrance conique plus courte qui termine l'abdomen."

shaped notch, and overlaps about two fifths the length of the 9th sternite; the outer edges of the notch a little flattened distally.

Agriogomphus, while approaching *Archaeogomphus* in the convergence of the branches of Cubital vein toward the wing margin, in having enlarged paranal cells and in remoteness of the anal crossing from the arculus, differs from that genus markedly in having the sectors of the arculus approximated closely after their widely separate origin, in having a basal subcostal crossvein, and in having relatively much narrower wings and generally denser venation.

The Nymph (described from the cast skin of the reared specimen) is in length 15 mm.; abdomen 10; hind femur 6; width of head 4; of abdomen 6. This is a broadly depressed brownish nymph with large, blunt, dorsal hooks and lateral spines on the abdomen. There is a russet tint to the closely mottle skin caused by silt from decaying leaves that closely adheres to the short, dense, scurfy, general pubescence. The head is flat above, widest across the rather small eyes. Antennae rather long and very prominent with the third joint distinctly clavate, straight, thinly fringed along the sides with long soft hairs; the fourth joint, a short conic rudiment. Above the base of each antenna there is a protecting ridge the outer end of which is raised in a small tubercle. There is another more prominent more broadly rounded tubercle arising behind each eye.

The labium is short and thick. Its mentum is very little longer than wide; its sides converge proximally and have a marked basal emargination for the hinge junction. Its lateral margins are fuzzy rather than merely pubescent. The front margin of the median lobe is moderately convex, and occupies about a third of the total width of the front; it is armed with about 25 long sharp tapering spines in a single open series. The bases of the lateral lobes stand well within the corners of the mentum. These lobes are short, bare and toothless on the inner side; the end hook is rather blunt, the movable hook very sharp.

The disc of the prothorax is bordered behind by a raised ridge-like margin partly surrounding in the rear a pair of flat smooth depressed areas. The synthorax is stout with broadly sloping sides. The closely appressed and parallel wing cases reach backward well upon the fifth abdominal segment. The legs are flattened down at the sides and the hind femora are very long. Front and middle legs lack the usual Gomphine burrowing hooks. The tarsi are slender and bare and armed with long straightish claws.

The abdomen is short and wide and greatly depressed, widest on segments 4 and 5, quickly tapering thereafter to the end. There are dorsal hooks on segments 3 to 9. They are small on 3 and 4, high, laterally flattened, blunt-tipped and conspicuous on 5 to 9, and regularly increasing in size to rearward. There are lateral spines on 3 to 9, increasing in size from front to

rear as far as 8, but on 9 shortened, small, close-laid against the sides of 10, and only about half as long as that segment. The caudal appendages are short, thick, blunt, and scurfy pubescent; the superior about three fourths as long as the inferiors, the laterals only a little over half as long. On the ventral side of the abdomen are two unusually deep straight parallel sutures with single, rather conspicuous rows of clustered "scars" between them and the side margin.

Material, as already stated under the description of the adult.

CYANOGOMPHUS Selys

This genus was established by de Selys [15] for a single male specimen that he named *C. waltheri,* from Brazil. The species was redescribed and better characterized and illustrated by Williamson in 1916.

In 1894 [16] de Selys added a second species, *C. demararae.* The description was based on an incomplete male specimen. It lacked the generically important end segments of the abdomen. It should be recognizable because of its two celled male triangle in the anal angle of the hind wing (in all the others, three celled). It was found in British Guiana, and perhaps it may yet be found in adjoining Surinam.

In 1905 [17] Calvert added a third species, *Cyanogomphus tumens,* from Mexico, basing his description on a single female; the only female specimen hitherto reported for the genus. The male was (and is) unknown, and on that account the species was rather doubtfully referred to *Cyanogomphus.* The swelling behind the eye that suggested the specific name *tumens* may be characteristic of any and all of the species that have been referred to *Cyanogomphus,* as Williamson apprehended.[18]

In 1916 Williamson published a good photographic figure [19] showing the wing venation of *C. waltheri,* with additional descriptive details, and he also described *conchinus* from Wismar, British Guiana, basing his description on a single male specimen. He referred this new species tentatively to *Cyanogomphus,* awaiting more adequate material for determination of its generic status; but he adequately described and illustrated it.[20]

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[15] Bull. Acad. Belg., (2), xxxv, p. 753, 1873.
[16] Ann. Soc. Ent. Belg., xxxviii, p. 173, 1894.
[17] Biol. Cent.-Amer., Neuropt., p. 169, 1905.
[18] Entom. News, xxvii, p. 167, 1916.
[19] Entom. News, xxvii, pl. 8, fig. 2, 1916.
[20] Entom. News, xxvii, pp. 168–172, pls. 8 and 9, figs. 1 and 6–10, 1916.

Herewith I present new material gathered by Dr. Geijskes in Surinam that includes another species closely allied to *C. conchinus,* together with a nymph and an exuvia that apparently belong to the same or to a very similar species. These I am making the basis of a description of a new genus and to this genus Williamson's *conchinus* will have to be transferred.

Before proceeding to describe the new genus, it may be well to take note of a fragment of a specimen that appears to belong to the old one.

?Cyanogomphus sp? Nymph (Pl. XIV, fig. 3.)

There is an incomplete (headless) specimen of an exuvia among the Surinam material of the Agriogomphus Complex. It is labelled "Suriname, Litanie, Feti Cr. On *Eichornia,* 7–VIII–1939." It seems most like *Cyanogomphus,* having granulated skin, bare of hairs, shorter and stronger legs, with well developed burrowing hooks on the first two pairs of tibiae and stout tarsi. It had dorsal hooks on abdominal segments 2 to 9, all conic, blunt tipped, stout and similar in form, in a regular series; the one on 9 is not enlarged. There are lateral spines on 4 to 9, all sharp, bare, outstanding at the sides, increasing in size on 4, 5, 6, about equal on 7, 8, and 9. The caudal appendages are sharp pointed and bare; the superior almost as long as the inferiors, the laterals half as long; the tips of the superior and inferiors upturned at the tip.

The abdomen is widest on segments 5 and 6. The relative length of the last four segments is about as 12:11:10:9, with the appendages 12 on the same scale. Unfortunately the labium is gone with the head. The fragments in alcohol are now in the Cornell University Collection.

Could this be the nymph of the missing *C. demararae* Selys?

The genus *Ischnogomphus* is still known from a single male specimen of *I. jessei* Williamson, from near Cristalina, Colombia.[21] It stands somewhat intermediate between *Agriogomphus* and *Cyanogomphus,* having no well defined male triangle in hind wings and a single row of cells behind vein Cu2 in the fore wing. It will be known by this combination of characters. The nymph is unknown.

[21] Occ. Pap. Mus. Zool. Univ. Mich., no. 52, p. 10, pl. 1, fig. 1; pl. 2, figs. 5–8, 1916.

EBEGOMPHUS[22] new genus

This is a highly specialized member of the Agriogomphus Complex, having all the group characters stated in a preceding paragraph (page 180); most nearly allied to *Cyanogomphus* from which it differs in the following particulars: The outer side of the fore wing triangle is almost or quite straight: not nearly so strongly angulated as in that genus. In the hind wing there are two rows of cells behind vein Cu2; three in *Cyanogomphus.* The anal angle in the male is only moderately prominent, it being bounded on the basal side by an open curve; in *Cyanogomphus,* by a quarter-circle bend. In the hind wing the third paranal cell is greatly enlarged; much longer fore-and-aft than the cell that stands behind it; in *Cyanogomphus,* not notably larger than adjacent cells. The genital hamules are in reversed order of size and of entirely different form; the anterior hamule is larger in *Ebegomphus* much smaller in *Cyanogomphus.* The nymph is widest across the 7th abdominal segment in *Ebegomphus;* widest across the 5th in *Cyanogomphus.* (See pl. XVI, fig. 4e.)

GENOTYPE: *Ebegomphus strumens* new species, described below.

The nymph is grotesquely broadened and flattened, with an abdomen as wide as long, and with dorsal hooks and lateral spines very much more strongly developed than in *Cyanogomphus.*

Ebegomphus strumens[23] new species

(Pl. XIV, figs. 4*a*–4*d*; pl. XVI, fig. 4*e*.)

This species is closely related to the *Cyanogomphus conchinus* of Williamson[24] from near Cristalina, Colombia. The most striking differences seem to lie in the hamules; the antero-internal angle of the anterior hamule rises in an erect, sharp and prominent tooth; the shaft of the posterior hamule is shorter, and the inner edge of its obliquely truncate tip is more deeply serrate.

Length 43 mm.; abdomen 34; hind wing 25.

This is a brownish species varied with dull yellow. The face is brownish, paler on its lateral aspects, its sclerites with narrow black edgings. Postclypeus and vertical part of the face polished and bare up to the top of the

[22] I name this genus in memory of my late lamented friend, E. B. Williamson, who was a most devoted and discerning student of the Odonata. He was called "E. B." by intimate friends about his home in Bluffton, Indiana, where I knew him best. I have merely spelled out these initials; if such derivation be unusual, it at least yields a name that is euphonious, indicative of taxonomic relationship, easy to remember, and not too long.

[23] *Struma,* a welt-like swelling at the neck (possibly the "King's Evil").

[24] Entom. News, XXVII, p. 168, 1916.

frons where there is fringe of slender hairs. Top of the head including the occiput is all obscure pale brown. The antennae are black with pale rings around their bases. The occiput is low, rounded above, with hardly more than a line of thin pale hairs to mark the place of the usual crest. At either end the occiput merges into a wider welt that extends laterally behind the eye to end a little lower down at a reentrant angle in the eye border. On the rear of the head below this point there is first a spot and then a marginal band of yellow.

The prothorax is all pale dorsally. Between front and middle lobes there is a deep transverse furrow. The large middle lobe is inflated, overlapping the narrow posterior lobe and riding high over it like a pair of saddlebags; its hind margin bears a long thin fringe of pale brown hairs. The middle portion of the hind margin of the hind lobe is margined with very minute denticles. The synthorax is yellowish in ground color, obscurely striped with dull brown, broadly in front, narrowly at the sides. On the front a pair of yellowish 7-marks delimit a middorsal triangle of brown that is divided by yellow on the carina. The surface of the broad convexities of the mesepisterna is wrinkled in close-set microscopic striations.

The legs are brown beyond the pale basal segments, externally on the femora and laterally on the tibiae, with black spines. The paler claws have black tips. The wings are hyaline with brown veins and stigma. Ante- and postnodal crossveins are 14:8/10:8 in fore and hind wings respectively. The triangle of the fore wing is equilateral. In the fore wing there is a single row of paranal cells. In the hind wing there are four paranal and three postanal cells. The third paranal cell is greatly enlarged. There are two rows of cells behind vein Cu2. (See pl. XVI, fig. 4*e*.)

The abdomen (much broken, but with the genitalis well preserved) shows little color pattern. It is slender, moderately swollen at both ends, paler on the basal segments and on the sides of 3 to 7; segments 8 to 10 are wholly brownish and the appendages are a little paler. The 10th segment is about twice as long on the ventral as on the dorsal side, with the appendages occupying the reentrant angle between. The caudal appendages and the genitalia of the 2nd segment are as shown in the figures on plate XIV. The anterior hamules are small and hollowed out; the posteriors, more or less sickle-shaped. The peduncle ("vesicle") of the penis is cleft into two concave quadrate plates, between which the appendages of the penis tip may lie folded together when at rest. A little notch in the proximal margin of each plate seems to provide a catch to hold in place a small chitinous knob on each side of the penis tip. The upturned tip of the penis guard ends in three straight teeth separated by rounded notches; the sharper middle tooth is longest. At the base of the inferior caudal appendage there is a very distinct projecting angle, that seems to be fitted to a notch in the adjacent margin of the subanal plate.

Holotype.—Male (now in alcohol); "Kabel Station, Surinam River; 25 IX 1938." Now in the Cornell University Collection.

Ebegomphus sp?

This species differs from *C. tumens* Calvert [25] in having pale caudal appendages, and especially in form of the subgenital plate (see pl. XIV, fig. 4*d*).

This may be the female of *E. strumens*. It came with the same lot of specimens from a different part of the same country, Surinam, and is of appropriate size. There are some structural differences, however, that have led me to keep it apart. So long as the two sexes are not known for any species of the Agriogomphus Complex, one does not know how much allowance must be made for differences of sex. I therefore describe it in some detail.

This is a greenish species. Dr. Geijskes furnished along with the specimen a brief field note concerning the color in life which reads: "Eyes, upper side blue; otherwise green, as are head, thorax and abdomen."

Length 45 mm.; abdomen 34; hind wing 25.

The labrum is green with a narrow blackish border. At each side this border is overlaid by a narrower yellowish)-shaped stripe. The clypeus is greenish with brown sutures, and washed with yellow on the projecting lobes. Frons green on the vertical face and on the front of the top, black on its rear above. Antennae black, their pedicels ringed with paler. The black-ringed ocelli are set in a forward-facing area of the vertex, whose upper level to rearward is brown, as is also the inner border of the eyes. Occiput paler brown, smooth, without crest line; there is, however, instead, a thin line of soft hairs, and these continue along the top of the thick- welt-like ridges that extend laterally behind the eyes to a rearward-projecting angulation of the eye itself, quite like that described by Calvert for *C. tumens*. The rear of the head is deeply concave, and just outside of the rim of the occipital foramen there is a pair of very deep (o)-shaped grooves, divergent downward, and of the same curvature as that of the inferior spurs on the superior appendages of the male of the preceding species (or, for that matter, of *E. conchinus*), and perhaps correlated therewith in form.

The thorax is greenish yellow marked with brown. In front is a mid-dorsal triangle of brown not reaching down to the collar, divided on the median line by the yellow carina. The long antehumeral brown stripe is interrupted toward its lower end. A narrower humeral stripe is constricted —almost interrupted—near its upper end, and then is narrowed downward to its conjunction with the humeral stripe at the lower end. There is a large vestige of a stripe on the upper part of the mid-lateral suture, and a small vestige on the third lateral suture. The metepimeron is pale yellowish green. Both front and sides of the synthorax are besprinkled with darker spots that give it a faintly freckled appearance.

[25] Bio. Cent.-Amer., Neuropt., p. 169, pl. 7, figs. 11 and 41, 1905.

The legs are blackish beyond their pale bases; first femora, darker externally; tibiae black, yellow on the outer side; spines and claws black. The wings are hyaline with brown veins and stigma; membrane slightly iridescent. Ante- and postnodal crossveins 14:14–15/11–12:12–13 in fore and hind wings respectively; arculus a little before the second antenodal in both wings; fore wing triangle equilateral; three postanal and five paranal cells in the hind wing, and three cell rows behind vein Cu2. The gaff (fused portion of veins Cu2 and A1) distinctly longer than the inner side of the triangle in the hind wing. Middle fork slightly but distinctly askew forward, especially in the fore wing.

The abdomen is brownish, paler basally, but darkened a little across the dorsum of segments 1 and 2, with broad dorso-lateral basal, greenish-yellow triangles on 3 to 7 covering most of the sides of 3 and nearly half the sides of 4 to 7; segments 8 to 10 brown; appendages pale with extreme tips brownish. The sides are nearly parallel, there being little enlargement of end segments at either front or rear. The subgenital plate is a very elongate triangle, its divided tip extending well beyond the apex of the sternum of 9; it is cleft longitudinally for half its length with the slender divisions extended parallel, or their extreme tips a little incurved; its base is constricted a little below the level of the cleft.

There is a single specimen bearing the data: "Litani River, Feti Creek, Surinam, 21 IX 1938"; now in the Cornell University Collection.

This female differs from the above described male of *E. strumens* by color differences (possibly in part due to immaturity) and by at least two points in venation (whether sex differences merely or not is not known to me); the gaff (fused portion of vein Cu2 and first anal vein) is longer than the inner side of the triangle in this female; much shorter than that side in the male *E. strumens*. There are three cell rows behind vein Cu2 in the hind wing of this female; only two in *strumens* male.

There is another female, possibly of the same species, among the specimens sent me by Dr. Geijskes, but it is so very teneral that it is wholly inadequate for color description, and the subgenital plate is apparently demolished. It probably is not a *Cyanogomphus,* for it lacks a third row of cells behind vein Cu2 in the fore wings. It is from "Coropina River, upper part, April 27th, 1943."

Cyanogomphus sp.? (supposition)

The nymph (measured on the badly broken skin of a female left behind at transformation) is in length 16 mm.; abdomen 9; width of head 6; of abdomen 9.

This is a very flat, hairy margined nymph with dark brown body and slender whitish tarsi. In form of body it is similar to *Agriogomphus* but with the peculiarities of the *Agriogomphus* complex greatly exaggerated. In shape and flattening of the body it parallels the nymph of *Hagenius*. The abdomen is as wide as long. Its dorsal hooks and lateral spines are much larger and more divergent than in that species, with the head relatively smaller and with rougher contours. The antennae are rather slender, the third segment a little clavate and flattened dorsally, with hair fringes along either side. The tubercle at the outer end of the post-antennal ridge is higher than in *Agriogomphus,* and the one behind the eye on the dorsum is lower. The labrum is narrow, about four times as wide as long, with a transverse, chitinous shelf-like submarginal ridge near the heavily hair-fringed front margin. It is narrowly trapezoidal with the wide end forward. The labium is short and wide, its mentum, a fifth wider than long; its median lobe rounded and thinly fringed with flattened and pointed scales, intermixed with a few long soft hairs; lateral lobes very short and stout, shorter than their own end hooks, and these are much shorter than the movable hooks and similar in form.

The thorax is narrow in front and greatly widened on successive segments; depressed, with broadly sloping sides. The legs, also, are very much flattened and depressed on their femora and tibiae and bear dense marginal fringes of soft brown hair. The slender tarsi are nearly bare and pale in color. The close-laid wing cases extend to rearward well upon the sixth abdominal segment.

The abdomen is very flat and nearly circular in outline with huge, blunt tipped and laterally flattened dorsal hooks forming a middorsal ridge. The hook on segment 3 is a mere rudiment; on 4 a small nipple-like affair; on 5 spine-like and reclined to rearward; while on 6 to 9, the hooks are suddenly very high, clad with a dense pubescence, increasing in size successively but with about equal backward inclination. There are lateral spines on segments 3 to 9, moderate in size on 3, increasing thereafter to 7, reduced two-thirds on 8, and on 9 almost vestigial and appressed closely to the side of segment 10. All are clothed with dense pubescence and appear blunt-tipped, but the larger ones end in sharp inturned spines that are scarcely discernible amid the pubescence. On the smooth underside of the abdomen there is a median row of pale spots underlying the ganglia of the nervous system within, and corresponding to these ganglia in size as well as position, the larger ones being on segments 2, 3 and 8. The caudal appendages are short, triangular-pyramidal, blunt-tipped, and scurfy-pubescent. The superior and the laterals are each successively a little shorter than the inferiors.

The apical margin of the ventral side of the middle segments of the abdomen is regularly concave to rearward, but a double concavity begins on segment 7 and increases greatly in depth successively on 8 and 9. The cylindric 10th segment has a distinct basal widening where clasped by the lateral spines of the 9th segment. These peculiar features are less pronounced in the younger nymph.

There are two specimens, both from Kabel Station on the Surinam River, collected November 25th, 1938 by Dr. Geijskes, and now in the Cornell University Collection. One is a nymph in the flesh, apparently near to its penultimate instar, with wing cases reaching to rearward to the middle of the fourth abdominal segment. The other is the broken exuvia that has been mainly used in the above description. Both were collected at about the same time and place as the adult male hereinbefore described. The nymph is fortunately well preserved and far enough along in development so that the venation in its wings can be studied in almost every detail. It agrees in all essential respects with the adult, and is, therefore, referred to that species with some confidence.

CACUS Selys

This genus was first described by de Selys[26] for the single species *C. latro* from British Guiana, and was not heard from again until 1940, when I described a second species, *C. mungo,* from Surinam. There are no adults in the material sent by Dr. Geijskes, but there are two exuviae, of suitable size to belong with the latter species. They are herewith described.

Cacus mungo Needham,[27] supposition (Plate XIV, figs. 5*a*–5*b*.)

Nymph in total length 22 mm.; abdomen 13; hind femur 5; width of head 6; of abdomen 15.

This is a stocky nymph with abdomen of very remarkable form: strongly depressed, high-ridged on the middorsal line and flaringly dilated on the lateral margins of the seventh segment. The head is moderately depressed, widest across a rounded and recurved lateral extension of the eyes. It is scurfy pubescent above, especially so on the convex front border of the labrum, along the ridge line that runs behind the bases of the antennae from eye to eye, and on the bluntly projecting hind angles. There are also three lesser streaks of brown pubescence before the middle ocellus, four more (two pairs) just behind the epicranial suture. The occiput is low, lacking distinct transverse ridge. The antennae are very slender and nearly bare,

[26] Bull. Acad. Belg., xx, (2), p. 97, 1854.
[27] Trans. Amer. Ent. Soc., lxv, p. 390, 1940.

convergent forward through their basal third and parallel thereafter to the tips. The third segment is slightly clavate, and the fourth is a mere vestige on the tip of the third.

The labium is short, its basal hinge reaching only to the middle coxae. The mentum is one-third longer than wide, parallel-sided or a little widened toward the hinge. On its margins are three little touches of brown on each side. The median lobe is strongly convex, almost a semicircle. Its free front is bordered by a row of about thirteen close-set, quadrate denticles, and the usual fringe of flattened and truncate scales. The lateral lobe is stout, strongly tapering from the base outward. Its movable hook is about as long as the distance from the basal hinge. The end hook is broadly rounded, not at all pointed, and the inner margin bears a continuous row of about twenty minute crenate denticles. From the prominent hind angle of the head behind the eye there runs a scurfy ridge obliquely downward and forward to another similar prominence just below the eye.

The disc of the prothorax is flattened, with a shallow transverse groove setting off a small anterior division, behind which is a strong lateral protuberance; below this on the side, lower down and a little farther forward is another similar scurfy pubescent prominence. The synthorax is moderately depressed above with low ridges on each side running down to the bases of the legs; the metepimeral ridge is raised midway its length into an angular prominence.

The legs are slender with both femora and tibiae twice ringed with brown; their scanty hairiness is confined to their rear margins. They are not fossorial; burrowing hooks are entirely wanting from the fore and middle tibiae. On the under side of the hind femora there is an extensive patch of microscopic abrasion nodules.

The abdomen is wider than long, very broadly depressed, and declined rooflike beyond the very large middorsal ridge of the seventh segment. In outline as seen from above it is abruptly widened on segments 1 to 4, and again but less abruptly on 4 to 7 where widest, and then narrowed still more abruptly on 7 to 9. The annular 10th segment appears to be dovetailed into the apex of 9, being wider at base than at apex. The lateral spines are all blunt, the backward-directed stubby spines of 8 and 9, most so. The spines of 7 become triquetral by reason of a dorsal ridge along their upper side extending rooflike outward from the body of the segment. The three dorsal hooks that arise between the wing cases are followed by high blunt-edged middorsal ridges on segments 6 and 7, highest on 7, and then they are suddenly shortened to rearward successively on 8 and 9. The relative length of the last three abdominal segments is about as 11:10:9, with the inferior appendages 10, on the same scale. The caudal appendages are short and blunt. The superior is a little shorter than the inferiors; the laterals are about two fifths as long.

Described from two exuviae labelled "Boven loop, Coropina Creek; 27 IV, 1943"; (D. S. Geijskes); one is in the Cornell University Collection and the other has been returned to Dr. Geijskes.

There is no clue to their identity except general structural likeness, but that places them in de Selys' Legion *Lindenia.* The best known of the members of this Legion are *Ictinus* and *Gomphidia;* nymphs of both are described and figured in my Manual of the Dragonflies of China, plate 4. An additional species of *Gomphidia* is also figured in my Dragonflies of the Philippines, plate 10. The Surinam nymphs are like these in the stocky form of body, proportions of labium, wide spread of the 7th abdominal segment and lack of tibial burrowing hooks. Our new world representative of that Legion is the genus *Cacus,* with two regional species, one of which was described from Surinam in my 1940 Gomphine paper. It is the one of size corresponding to the size of the nymph; therefore, the reference by supposition to that species.

APHYLLA

There are but three specimens representing this genus in the material sent by Dr. Geijskes: one from Trinidad, an apparently new species, that is hereinafter described, and two from Surinam. Of the latter, one is an adult *Aphylla producta* Selys [28] and the other is a cast skin that may belong to the same species, and that has not hitherto been made known.

Aphylla producta Selys supposition
(Pl. XIV; figs. 7*a* and 7*b*; pl. XV, fig. 7*c*.)

The nymph measures in length 44 mm.; abdomen 34, of which segment 10 measures 8; hind femur 5; width of head 6; of abdomen 6.

This is a patternless silt-covered nymph, with much hair about the face and fore legs, but with only thin lines of hairs on the hind tibiae and along the nearly obsolete lateral carina of the sub-cylindric abdomen. The antennae are long, densely pubescent, parallel-sided, and their fourth joint a rudiment half as long as the third is wide at the tip. The top of the head is scurfy with a number of bare streaks: three extending forward from the ocelli, the middle one V-shaped; three roundish ones lined up across the rear of the head. A larger pair lies on the disc of the prothorax, and there are the usual sinuous bare lines on the femora. The mentum of the labium is narrow and parallel-sided, its front margin deeply recessed to the convex middle lobe, which is dished out and armed with about fifteen sharply pointed up-curving flattened scales. The lateral lobes appear to be set up on pedicels; the end hook is long and sinuous and before it on the inner margin are four long, irregularly, dagger-shaped teeth, the proximal one much smaller than the others.

[28] Bull. Acad. Belg., XXI, (2), p. 79, 1854.

The legs are short; the end of the crooked front tibia is truncated and notched for the reception of the tarsus; at the outer side of the notch stands a short sharp tooth, and at the inner side, instead of the usual burrowing hook, there is a large very blunt and hairy rounded lobe. There are no dorsal hooks, but on segments abdominal 3, 4 and 5 there are low rounded humps. There are no lateral spines at all. The caudal appendages are of about equal length each to each, and all have sinuous margins.

The single exuvia from which this description is drawn bears the label "Coropina Creek, Surinam; 13–VIII–1941"; in the Cornell University Collection.

Aphylla cornutifrons new species (Pl. XIV, fig. 6.)

Length 32 mm.; abdomen 38; hind wing 33.

Female. This is a clear-winged, nearly hairless species, at once remarkable for an extraordinary pair of horns arising from the top of the frons. Face dull brown in color, darkening downward with the margin of the labrum blackish and fringed with long tawny hairs. Frons slightly olivaceous, with a pair of horns, nearly double the height of the face, arising erect at the sides in front of the lateral ocelli. Each of these horns is broadly conical at the base and tapers upward to a long acuminate point. The usual frontal ridge is present only in the middle portion, being replaced on each side by the swollen base of one of the horns. Antennae blackish, narrowly ringed with white at the joinings of the thick basal segment. Ocelli ringed with white. Vertex and occiput brownish olivaceous. Occipital margin straight, scantily fringed with hairs.

Prothorax obscure. Synthorax brown in front; dorsal stripes ill-defined, pointed and isolated above, widened downward to a rather broad confluence with the yellow of the collar. Antehumeral pale stripe wanting. The three lateral pale stripes all very obscure and ill-defined; perhaps the sides would be better described as yellowish to rearward with the sutures becoming brownish.

Leg-bases pale; femora brown, becoming blackish at the knees; tibiae and tarsi black. Wings hyaline with blackish veins and a brown stigma. Costa black. Antenodal crossveins 21–22: 14 and 15–16: 15–17 in fore and hind wing respectively; the first and sixth (in one wing the seventh) thickened. Triangle of the front wing equilateral, two-celled, decidedly longer in front than the sub-triangle, and followed by two long rows of cells. Triangle in the hind wing one-third longer in front than on the inner side, followed by two rows of cells with two extra cells next to triangle. Subtriangle one-celled. Anal loop two-celled. Vein A2 straight, with vein A1 bent toward it at the rear of the anal loop. Postanal row irregular, of four to six cells. Between veins A1 and A2 two rows of four cells each extend rearward to the wing margin.

Abdomen rather stout, only a little thickened at the base and not at all at the apex. Color at the base dull yellowish; on the apical segments blackish, with the intervening segments half-ringed with yellow basally, the half ring

becoming sharply defined only on segment seven. Segments 8 and 9 are not laterally expanded, but are washed with the yellowish red low down on the sides. Dorsally they are black and 10 is wholly black. Appendages yellow, blackish at the base. The relative length of the four terminal segments is 22 : 15 : 10 : 9, with the appendage 11 on the same scale. Subgenital plate blackish, hardly produced at all to rearward, slightly concave on its rear margin.

Type.—Female; collected on July 14, 1929, in Mt. St. Benedict ravine, Tunapuna, Trinidad, by Dr. D. C. Geijskes. It is in the Cornell University Collection.

Though there is but a single specimen and that a female, the extraordinary character of the frons surely justifies the description, and the bestowal of a name.

GOMPHOIDES

Of this large and somewhat puzzling genus there are three species in the material now before me: one, *G. fuliginosa* Selys, has long been known from British Guiana; the two others appear to be hitherto undescribed.

Gomphoides fuliginosa Selys (Pl. XV, figs. 8*a*–8*e*; pl. XVI, fig. 8*f*.)

The female of this species was first briefly described by de Selys in 1854,[29] and more fully in 1858.[30] Further description based on new materials (including the male) was published by him in 1894.[31] No figures of the male have been offered hitherto. I now have a series of seven males from Surinam, and a Brazilian female specimen borrowed from the United States National Museum; also, a single exuvia that I refer to this species, from Bartica, British Guiana, loaned to me by Dr. P. P. Calvert. All this material being in excellent condition, I have used it to provide ampler descriptions and figures of both adult male and nymphal stages.

Length 76–77 mm.; abdomen 56–58; hind wing 42–43. (One small specimen, otherwise identical, measures only 67.)

Face black and greenish yellow. Labrum black, with a pair of large, roughly triangular, yellow spots in midfield. Anteclypeus yellow. Postclypeus black, yellow at the sides. Frons mostly black both in front and at the rear, but with a medially interrupted and somewhat uneven yellow band covering its somewhat bilobed prominence above. Antennae black, the basal joint narrowly ringed with yellow. Vertex blackish, with a pair of low mound-like prominences behind the lateral ocelli. These are tufted with short hairs. Occiput black, with a large central spot of bright yellow, its straightish crest with the usual fringe of long hairs.

[29] Bull. Acad. Belg., XXI, (2), p. 73, 1854.
[30] Monogr. des Gomphines, p. 211, 1858.
[31] Mem. Soc. Ent. Belg., XXXVIII, p. 175, 1894.

Prothorax wrinkled and hairy, its narrow and crescentic hind lobe velvety black. Synthorax rich dark umber brown, brightly striped with clay yellow. Collar yellow at the sides; not at the middle point. Middle of carina yellow. Dorsal yellow stripes divergent forward, abbreviated at both ends. Antehumeral stripes wider and much longer, constricted near the upper end, and widened below where they overspread the humeral suture. Sides with three sharply defined yellow stripes all isolated at their upper ends. The midlateral stripe covers the rear half of the spiracle and runs down on the hind coxa.

The legs are all entirely black beyond the short basal segments, save only the front femur which is yellow on the under side. The wings are hyaline with black veins and stigma, and with a very narrow and inconspicuous pale antenodal line on the serrated front margin of the costa. A brush of long brown hair rises from the ridge connecting the wing bases on each side.

The venation of the wings is unique in having the narrow forewing triangle greatly elongated at right angles to the length of the wing. The front side of the triangle is one-fifth shorter than the inner. Both triangle and subtriangle are normally four-celled in the front wings and three-celled in the hind ones. In the 32 wings before me there occur only four exceptions; in two front wings they are five-celled, and in two hind wings, two-celled. A strong anal loop is made of the two first cells of the postanal row, but in two of the wings before me the larger anterior of the two cells is divided by an additional weak crossvein at right angles to the one normally present. There are constantly two crossveins traversing the supratriangular space in all wings. In the wide space behind vein Cu2 there are rather large cells that, though still hexagons, show a tendency to shape themselves in quadrangular form and to fall into regular lines that parallel the wing margin.

Abdomen black, scantily marked with yellow. Two large spots, one covering the lower half of the sides of segment 1 and the other the auricles of 2, together form an interrupted yellow band that parallels and continues to rearward the pattern of yellow stripes on the side of the thorax. The margins of the genital pocket on 2 are also narrowly yellow. There are little middorsal yellow basal spots on segments 3 to 7, largest on 3 and 7, smallest on 6, with an additional midlateral basal spot on 3, and the inferior edges of these same segments are very narrowly yellow. Segments 8 to 10 are all black. Appendages black, the tips of the superiors yellow. Segments 1 and 2 are densely clothed on the dorsal side with long brown hair that tends to run in transverse cross bands or strips, one strip on 1 and two on 2.

In form the abdomen is slender and parallel-sided through most of its length. The unusually short basal enlargement involves only the very base of 3. The yellow auricles are large and bag-like, flexed to rearward, with the bottom of the bag thickly besprinkled with minute black denticles, and on their inner face next to the body of the segment there is a tuft of thin brown hair. The hair on 2 in front of the auricle is soft and downy, similar to the hair on the end of the segment; of a different character from that on the dorsum.

The anterior genital hamule is of a very complicated form. It is transversely and deeply divided into two parts, the rear one of which stands

erect, with its blunt black tip plainly visible from the side. The front part is bulbous at the base and then suddenly tapers into a long, thin, linear, backwardly directed point and runs around and inside the rear part. The two tips of this pair extend far forward and become slightly convergent and curved toward the sternum at their blackened and pointed ends. They cover the slightly emarginate tip of the penis guard. The posterior hamule is prominent, twice as long as the anterior, somewhat sigmoid in curvature, somewhat angulated and very hairy along its ventral edge, strongly aslant and tapered to rearward to end in little hooks. The peduncle ("vesicle") of the penis is long and low, its hood cleft into two oval plates between which lie the straight and somewhat chitinized penis tips ("cornua"). The latter reach to rearward about to the level of the base of the peduncle.

Segment 3 of the abdomen is but little involved in the basal widening of the abdomen. That short narrowing portion is thinly hairy on the sides; the long parallel-sided part is quite bare. The very conspicuous enlargement of the end segment of the abdomen involves only the tip of segment 7, but 8 doubles the diameter, and extends the side margins in broad leaflike expansions that widen broadly to rearward and extend to one-fourth the length of 9. The similar expansions of the sides of 9 are only about a third as large, and terminate at the level of that segment. Segment 8 is slightly and segment 9 is strongly elevated along the middorsal line, the ridge becoming subcarinate where it ends in the enlarged denticles of the apical margin of these segments. The relative lengths of the three last segments are as about 14:10:9, with the appendages 15 on the same scale. The form of the appendages is as shown in the accompanying figures.

Of the seven male specimens from Surinam, three are retained for the Cornell University Collection, two are in the collection of the Academy of Natural Sciences of Philadelphia, and two have been returned to Dr. Geijskes.

The chief venational peculiarities of this species are the narrow front wing triangles, more elongated perpendicularly to the axis of the wing than in any other Odonata known to me excepting only some Libellulinae; the regular division of both triangles and subtriangles into four cells in the front wings and three in the hind; the anal loop of two large cells within a well defined boundary; the strongly forked vein A2, and the single row of large cells, diminishing much in size to rearward, between A2 and A3.

The nymph (*Gomphoides fuliginosus* Selys, supposition) measures in total length 42 mm.; abdomen 29; hind femur 6; width of head 8; of abdomen 13.

This is a concolorous patternless nymph of depressed form with long hair fringes about the labrum, the sides of the antennae, legs and abdomen. The dorsum is mostly bare of hairs, but its more convex upper surfaces are finely granulate. The head is depressed and widest behind the middle of the eyes.

The labrum has a much thickened front border, and at its lower edge, well below the external fringe of long hairs there is an inner transverse line of between 25 and 30 short sharp spines, all pointed to rearward, on the under side of the labrum. Behind these spines is a bare basal transverse area, and behind that area there are numerous more minute scattered flat-lying spinules, pointing throatward. The usual prominences between the antennae and the eyes are low and hairy. The hair-margined third segment of the antennae is more than three times as long as the two basal segments together. It is depressed and decurved at the middle and tapered toward both ends. Segment four is a mere vestige. The labium is very strong, but not unusual in length; its middle hinge rests against the middle coxae. The sides of the mentum are convergent backward to the middle hinge. The middle lobe is slightly convex at the sides but nearly straight in the middle third of the free margin. It is bordered by a row about thirty straight-ranked spinules, and there is an underlying row of less numerous and less regular spinules two-fifths as long. The lateral lobe is rather short and stout, with its long end hook regularly and so strongly curved that the point is directed straight to rearward. On its inner side there is a row of irregular teeth. The largest of these teeth is in the middle of the row. Proximally the others become ill-defined. The movable hook is very long and strong, black and slightly swollen in its basal half, paler and smooth beyond to the tip.

The disc of the prothorax has a pair of large quadrate bare areas, that are narrowly confluent at their inner anterior corners. The postero-lateral angles of the disc are roundly bulging. The synthorax is much widened to rearward.

The legs are rather stout; femora short, and tarsi rather long. The usual bare lines on the femora are narrow and inconspicuous. The plantar surface of the tarsi is clothed with short stiff hairs; the front tarsi have also a long hair-fringe on the outer side, and the tip of the claws sub-falcate. The front and middle tibiae are armed each with a stout burrowing hook.

The abdomen is broadly depressed, lanceolate in outline, and has thick sub-conical dorsal hooks on segments 2 to 9. These are small on 2 but regularly increase in height to rearward and are highest on 9. There are lateral spines on 5 to 9, likewise increasing in size to rearward; simple on 5, but acquiring on the other segments a pale inner sub-apical lobe that makes them unique in form. The relative middorsal length of the last four abdominal segments is as 8 : 9 : 10 : 12, with the inferior appendages about 15 on the same scale; the superior and the inferiors successively each a little shorter. The extreme tips of the superior and the inferiors are acute; of the laterals, acuminate. The usual "scars" along the sides of the abdomen are not large or prominent.

Described from a single exuvia kindly lent me by Dr. P. P. Calvert, bearing the label "Kartabo, Bartica District, British Guiana, 7 IX 1920. C. W. Beebe." [32]

[32] [This exuvia forms part of a collection of British Guianan Odonata on which I am reporting for Dr. Beebe. I have taken the liberty of lending it to Prof. Needham in the belief that he is in a better position to identify it than I am. P. P. Calvert.]

This is the largest Gomphoides nymph I have seen; and it is referred to the largest known species of the genus by supposition largely on account of its size and source, but also because it differs from other known nymphs in the unique armature of its labium and form of lateral abdominal spines about as much from the other species as the adult differs by its strong two-celled anal loop, its narrow and its straight-sided fore wing triangles.

The venational characters cited at the end of the description of the adult, together with those of the nymph just indicated, would perhaps justify the erection of a new genus for this species and its near ally, *G. audax*. De Selys set them apart in a separate group of species when he first described them in 1854. But the latter species I have not seen, and other species unknown to me may be intergradient, and the nymph above described is placed in this species by supposition only; and generic placement may well wait on further collecting and rearing.

Gomphoides undulatus new species (Pl. XV, figs. 9*a*–9*e*.)

This species is very distinct from all other species of Gomphoides known to me in the J-shaped form of its superior male appendages. It shows some resemblance to *G. infumatus,* type of the genus (as figured carefully by Hagen [33]), in the remarkably long, straight cornua of the penis, but the caudal male appendages, both superior and inferior, are very different. It somewhat resembles *G. fuliginosus* in having the anal crossing of the hind wing close to the subtriangle—distant by not more than a third of its own length—and in the general conformation of the parts behind the level of the triangle in that wing. It resembles *G. cristatus* in the great abbreviation of the 10th abdominal segment. It seems to differ from all in having posterior hamule smaller than the anterior.

Length 54–59 mm.; abdomen 41–43; hind wing 30–31.

This is a blackish species brightly striped with greenish yellow. The face is black, thinly clothed with hair, and fenestrate with paler as follows: there are two round greenish spots on the labrum; there is a large yellow spot externally on each mandible, with another narrower greenish one between that one and the eye; the anteclypeus is whitish, tinged with green; there is a greenish spot on either side of the postclypeus, and there is a wide stripe covering the low prominence of the frons, narrowed on the middle line. The

[33] Monogr. des Gomphines, p. 11, fig. 4f, 1858.

antennae are black, ringed narrowly with paler at base. The vertex is black. The obscure ridge behind the ocelli rises in a pair of low mound-like prominences, each tipped with a tuft of longer blackish hairs. The occiput is blackish with a large round yellow spot in the middle of its front; its hind margin is very slightly convex and bears a marginal fringe of long, thin, black hairs. The rear of the eyes is black, but the yellow spot upon the occiput seems to show through as by transparency. The rear of the mouth-parts below is pale, marked with two unequal pairs of streaks of greenish white.

The prothorax is pale, with only the rear edges of its middle lobe and its very narrow hinder lobe narrowly blackish. The synthorax is of a rich dark amber brown or blackish color, narrowly striped in front with yellow on the middle of the carina, and on the sides of collar. Narrow antehumeral stripes, divergent downward, do not reach either the collar or the crest. The four pale stripes on the sides of the thorax grow successively broad to rearward. Each of them is widened a bit at its upper end, the foremost (antehumeral) one sometimes interrupted just below this dilatation; the third is dilated broadly at its lower end. The venter is yellow.

The short legs are black beyond their pale basal segments, with the pallor on the foremost pair extending a little way beneath the front femur. The tibial comb on that pair is composed of eight flattened scales, with a larger black spine at the distal end of the row. The wings are hyaline, with a slight flavescence in the membrane at the base; with black veins, including the costa, and brown stigma. The middle fork is slightly askew forward; vein M3, distinctly undulate in both fore and hind legs, M4 less so; tips of the two veins slightly convergent at the wing margin. Basal subcostal crossvein present, with the first and fifth or sixth antenodal beyond it thickened. In the series of eight males before me the nodal crossveins are variable, the mode being 20 : 12/12 : 14 in fore and hind wing respectively, with variants, plus or minus one or two, in all four positions. The front side of the triangle is a little shorter than the inner side in the fore wing, longer in the hind wing. The triangle is three-celled in fore and hind wings, with a difference in arrangement of the dividing crossveins: tri-radiate from the center in the fore wing; transverse to the more elongate triangle of the hind wing. The pentagonal anal loop is three-celled, with the gaff (fused portion of veins A1 and Cu2) about two-fifths as long as the inner side of the triangle. In the hind wing the triangle is constantly three-celled and the subtriangle two-celled. Veins A1 and A2 behind the anal loop strongly diverge, with one, two and four cells normally intervening successively to rearward, making the spread to the wing margin. Basal male triangle uniformly four-celled, with one cell in the axial angle, a vertical row of three following and reaching to the prominent hind angle of the wing. An adjacent parallel row between veins A2 and A3 consists generally of four cells, sometimes three or five.

The abdomen is black along the slender middle segments, marked with yellow on the enlarged segments at each end. Segments 1 and 2 are obscurely paler and densely hairy on the dorsum; sides of 1 and 2 yellow inferiorly, which color overspreads the auricle and runs down to the genital pocket beneath.

Segment 10 is of very peculiar form; nearly three times as long mid-dorsally as mid-ventrally. Its sides are obliquely truncated from the lower level of the thick base of the superior appendages downward. The apical border of the sternum is concave and the inferior appendage appears from the side as if suspended in the emargination. The long thick superior appendages are J-shaped and hooked downward. They are brown with black tips, hairy at the base on the inner side. They are divergent at base and then convergent as they turn downward to their obtuse, obliquely truncated, spiniferous, approximated tips. They are channeled lengthwise on the inner side, with upper edge inflexed toward the base and produced at the bend in a long, thin, flat, finger-like spine that reaches parallel halfway to the apex, and that is not visible in a lateral view. A long, thin, sharp spine, almost as long as the appendage is thick, projects directly downward from the inferior margin near the base. The inferior appendage is about one-fourth of the length of the superiors, thin, flat, deeply divided by a V-shaped cleft, black in color and it has a paler, brownish, hairy base. At the bottom of the cleft is a pale hairy median basal lobe.

The pleural edges of the genital pocket on segment 2 are densely hairy. The anterior lamina is rather large and bare, subquadrate in form, with rounded and slightly offset outer angles. It is completely consolidated with the anterior hamules and both are hairy in the depths within. The anterior hamule is two-parted, its forward division is very broad, transversely inflated and pale in color; the rear division is longer and more projecting and more heavily chitinized, and ends in a very short, gently incurving hook. The posterior hamule is smaller, simpler in form, paler in color, inclined as usual more strongly to rearward where it ends in a short blunt hook. The penis has a very long peduncle (basal segment: "vesicle"), much longer than the two other segments combined. The third segment bears at its tip a pair of very long slender cornua that extended far to rearward through the trough formed by the reflexed hood of the cleft peduncle. They extend straight and parallel for half their own length beyond the peduncle, and lie against the sternum of segment 3, which they almost equal in length. They are infuscated and chitinized out to their very slender tips.

Female and nymph unknown.

Holotype.—Male; Upper Litanie River; 19, VII, 1939; (D. C. Geijskes, collector); [in the Cornell University Collection].

Paratypes.—Seven additional males: two from Palumen, 24, VII, 1941, one from Tapahonie River, 15, IX, 1941; one from Mapaonie River, in the Cornell University Collection. One from Litanie River, 3, VIII, 1939 and one from Tapanahonie River, 15, 9, 1941, are in the collection of the Academy of Natural Sciences, Philadelphia. Two others are returned to Dr. Geijskes in Paramaribo: one, Republiek, Coropina Creek, 9, IX, 1942, and one, Mapaoni River, 15, LX, 1941.

Gomphoides cristatus new species (Pl. XV, figs. 10*a*–10*c*.)

This species is perhaps as nearly related to *G. semicircularis* as to any other. Hagen's figures of the male genitalia of that species [34] show very considerable morphological differences, most striking of which are the presence of a deep subapical cleft on the inner side of the male superior appendage in that species, and a much longer inferior appendage, divided by a simple V-shaped cleft.

Length 55 mm.; abdomen 45; hind wing 35.

Male. This is a blackish species, the thorax striped with tawny yellow in the male, with greenish yellow in the female. The face is blackish; labrum very black, with a pair of small tawny yellow spots wide apart. The anteclypeus and the outer edges of the postclypeus are also tawny yellow. The frons is brown in front and on the rear above, but the upper surface bears frontwards two large tawny yellow spots that almost meet medially, where the brown advances from the rear. The vertex rises to a low crest behind the ocelli, capped by a pair of low conical tubercles, and on its rear side it is thinly clad with hair. Before this crest it is shining black; behind it brown. The occiput is brown with a tawny oval median area and fringed with long black hair.

The prothorax is brown, obscurely and scantily marked with paler. The synthorax is a deep chestnut brown on both front and sides, striped with tawny yellow. A cross stripe on the collar is narrowly interrupted at its junction with the brown carina; the stripes of the dorsal pair are short, narrow, divergent, and isolated, and they end far above the collar. The crest is black. The four stripes on the sides are nearly equal in width; all are isolated at the upper end next the wings, and confluent at their lower ends. The legs beyond their pale short basal segments are black except for the yellowish under side of the front femur. The wings are subhyaline with blackish veins and clear brown stigma. Their membrane is slightly tinged with yellow at the base. The arculus is at or near the second complete antenodal crossvein. Both triangle and subtriangle in fore wing are three-celled: in the hind wing, three-celled and two-celled respectively; the anal loop is two-celled in one male specimen, three-celled in another. The gaff (fused portion of veins A1 and Cu2) is only about one-third as long as the inner side of the triangle in the hind wing. Veins A1 and A2 are strongly convergent to the rear side of the loop, with first one and then two and then four cells in order filling out the interspace beyond to the wing margin, and with the distal part of vein A2 strongly convergent with A3. There are five postanal cells.

The black abdomen is slender on the middle segments and considerably enlarged at both ends. There are tawny yellow middorsal areas on the base of segments 3 and 7; on 7 large and quadrangular, covering the basal two-fifths of the dorsum; there is a smaller one similarly placed on 2, and a faint suggestion of one on 5. Low down on the sides there are paler edgings on

[34] Monogr. des Gomphines, pl. 12, figs. 1*a* to 1*g*, 1858.

segments 3, 7, and 8. Segment 10 and the caudal appendages are black. Segment 7 is widened in trumpet-form—a flare at the end. Segments 8 and 9 are laterally compressed, becoming twice as high as wide. There is a middorsal carina on 4 to 9 that increases in height and sharpness to rearward and ends on 8 and 9 at a pair of enlarged denticles of the transverse apical series. The relative middorsal length of the last four abdominal segments is as 22:14:10:8, with the caudal appendages 8 on the same scale. The segment is only about one-fourth as long on the ventral as on the dorsal side. There are leaf-like lateral expansions on segment 8, followed by non-leaf-like side strips on 9; on 8 the expansion begins at the base and widens regularly to the level of the apex of the segment, and beyond that level it ends in a rearward-projecting rounded lobe.

The genitalia of the 2nd segment are of little prominence. The hood of the peduncle of the penis is reflexed backward until almost parallel with the abdomen, and deeply cleft in halves on the median line, with the halves together forming a trough in which lie the long slender upcurving cornua of the tip when at rest. At the middle of the base of the cleft there rises a short spine, and an inner ridge leading to the spine makes the bed of the cleft a double depression. The cornua are about as long as the body of the third penial segment that bears them. The superior caudal appendages of the male are roundly forcipate. They meet just before their sharply downturned tips. Each is channeled internally beyond a basal widening, and the upper margin is strongly inflexed just before the base of a sharp end spine. In lateral view the superiors are nearly straight in their basal two-thirds, then bent downward obliquely, then narrowed to the long end spine that is directed straight to rearward. The inferior appendage is at a very minimum of size for this genus; it is hardly one-tenth as long as the 10th segment. It projects downward but little below the subanal plates; it is threelobed, and the paler middle lobe is hairy, the lateral lobes, bare. It is slung beneath the undercut 10th segment, proximal to the base of the superior appendages. Across the underside of the superior appendages there runs a low, oblique basal ridge inward to form a little projecting angle at the point where the strong circular curve of the inner margin begins.

Female. Similar in color pattern with the paler markings more extensive and of a brighter yellow, tinged with green. The top of the frons is yellow all the way across; the outer side of the mandible is bright yellow. The hind femur is half yellow. The tinting of the wing membrane is a little more extended. The series of middorsal spots on the abdomen is continuous from 2 to 7; there are small basal side spots on 8 and there are touches of yellow on the expanded lateral margin of 8 and 9 and on the apical margin of 8, 9, and 10 and on the inner side of the long straight and smoothly tapering caudal appendages. The subgenital plate is divided deeply by a V-shaped notch into two bluntly rounded lobes, and extends beneath the basal fourth of segment 9. It projects obliquely downward and half its length is plainly visible in a side view of the abdomen.

Clearly *Gomphoides cristatus* is a border-line species. I was at first inclined to consider it a big *Cyclophylla* on account of its extremely reduced male inferior caudal appendage, deeply under-cut tenth abdominal segment, and general likeness to that genus in genitalia. The anal loop may sometimes be two-celled and of the same form as in *Cyclophylla;* but for that matter, the anal loop in *Gomphoides fuliginosus* is regularly so.

Holotype.—Male; "Paroe River, upper part, Jetoelumpe-Soela; IV, I, 1941; Schmidt." In the collection of the Academy of Natural Sciences of Philadelphia. The specimen also bears Dr. Geijskes No. 21.

Allotype.—Female; "Litani River, Waremapan Creek Waterfall at the beginning of the Indian Trail; 23 VII 1939; by Geijskes." Also, on the label, this note on coloration in life: "Eyes green; head, thorax and abdomen green, yellowish spotted." Geijskes' No. 31. Now in the Cornell University Collection together with the following.

Paratype.—Another male; "Coestoeimine Creek; 25 XII 1940." Geijskes' No. 22.

CYCLOPHYLLA Selys

Two species of this genus are represented in the material sent me by Dr. Geijskes: a single pair of *C. signata* Selys, the type species of the genus, hitherto reported only from Brazil; a nice series of closely related species that is apparently new, and that is hereinafter described as *C. pachystyla,* together with four exuviae that are referred by supposition to the same species.

Cyclophylla pachystyla new species (Pl. XV, figs. 11*a*–11*d*.)

This species is closely related to the type of the genus, *Cyclophylla signata* Selys, and to several other species that have the same stature and general type of genitalia; especially to *C. gladiata* Selys. An undescribed Venezuelan species is smaller (hind wing 27 mm.) and differs by having a one-celled anal loop, only three postanal cells, and an upturned spine on the end of the superior appendages of the male. All other species are rather easily distinguished in the male sex by differences in conformation of the superior caudal appendages, and by form of the exfoliations of the 8th and 9th abdominal segments. There is striking likeness to the type species

in the extremely long and twice coiled 'cornua' of the penis; transparent and fringed along the entire outer side with microscopic serratures.[35] These cornua are about as long as the entire penis from which they spring. They must coil rather tightly to lie when retracted concealed within the hood.

Length 52 mm.; abdomen 39; hind wing 30.

Male. This is a slender species, with heavily clubbed abdomen in the male. Face greenish, cross-striped with brownish black, shining and bare except at margins. Labrum brown, with a mid-basal mark and a wider marginal band of yellow, and a fringe of tawny hairs.

The outer face of the mandibles is green in color; also the entire anteclypeus, a basal stripe across the postclypeus, that stripe widening at the ends, and almost the whole of the frons above its low transverse carina. The antennae are brown, faintly ringed with paler on the joinings of the two basal segments; vertex and occiput wholly brown. There is very little development of an ocellar ridge. The crest of the occiput is very slightly convex and thinly fringed with soft concolorous hairs.

The prothorax is pale, darker on front and rear lobes of the dorsum; synthorax striped with brown and yellow; in front, more brown than yellow, and narrowly edged with yellow on carina and crest. The dorsal stripes are wide, truncate above and regularly widened downward and broadly confluent with the yellow of the collar. The antehumeral stripe is slender but very variable in width, widened at both ends and sometimes interrupted just below the upper widening. The three well developed lateral yellow stripes are of about equal width in their narrow part; all are widened at the upper end, the third stripe greatly so. The first and third are isolated below, but the middle stripe runs down to join the yellow of the hind coxa.

The legs are yellowish basally and on the under side of the front femora, with darkening femora that become black at the knees; all black beyond. Wings more or less hyaline, the membrane being moderately tinged with brown; veins blackish, costa and stigma brown. Nodal crossveins 18–22: 12–14/13–15: 13–15 in fore and hind wing respectively, and with the fifth or sixth (in one case, the seventh) antenodal thickened. Triangle of the front wing three-celled (sometimes two-celled) followed by two rows of cells, and generally, an extra cell at the start; in the hind wing, consistently two-celled. Sub-triangle two-celled in the fore wing, one-celled in the hind. Anal loop well developed, two-celled, with veins A1 and A2 converging to its rear and strongly diverging thereafter to the wing margin. In the hind wing the paranal cells are four, the postanals, three or four in the male, four or five in the female. Two enlarged cells stand squarely between the rear side of the anal loop and the row of smaller cells at the wing margin.

[35] See Hagen's figures in Selys' Monogr. des Gomphines, pl. 12, especially fig. 4j, 1858.

The abdomen is very slender and almost black on its long middle segments. It is suddenly expanded on segment 8, and becomes tinged with rusty red on the sides. There is a middorsal stripe of yellow on segments 1, 2, and the base of 3, with a touch of the same color on the side of 1 below, and on 2 higher up where the yellow covers the upper half of the auricle. The lateral edges of the genital pocket are fringed with stiff yellowish hairs. A row of obscure basal paler spots higher up on the sides of 3 to 7 merges into a band of rusty reddish brown on 7 to 10; remainder of dorsum and sides black. The leaf-like expansion of the side margins of segment 8 doubles the width of the segment, and it is widest at midway its length. A rounded lobe projects rearward from it a little beyond the body of the segment. The sides of segment 9 are expanded only in a narrowly triangular strip that is widest at the base and regularly tapers to the apical margin of the segment. The minute spinules on the transverse apical carina of segments 8 to 10 become successively larger to rearward, and stand stiffly erect on the apex of 10, with a minute V-shaped notch interrupting the line middorsally. The relative length of the three terminal abdominal segments is as 15:10:8; appendages 9 on the same scale. There is no tubercle on the sternum of the first abdominal segment.

The forcipate superior abdominal appendages of the male are very stout, their vertical breadth equalling two-thirds that of the 10th segment. They are brown outside, paler within, with a narrow yellow line on the upper edge except at its ends. At their blunt, broadly truncate, blackish tips they are externally hairy. At the ends of the yellow stripe on the upper edge a thin inturned strip of the upper margin is set off by a shallow notch, beyond which the whole blunt end of the appendage is down turned to end in an obtuse angulation. Just beyond the base of the superior appendage its inferior margin carries a plate-like downward expansion, that narrows thereafter to the subapical bend. The inferior appendage is vestigial. The genitalia of the second abdominal segment are as shown in the accompanying figures. The deeply cleft hood of the penis is tilted to rearward, trapezoidal in form with rounded corners.

Female. Similar to the male in size and coloration, but with very little dilatation of the end segments. The pigmentation is lighter. The green of the face is tinged with yellow, and the abdomen is brown instead of black, with large diffuse black saddle marks covering most of the dorsum of the last three segments. The spines on the distal half of the outer row of the hind femora are only four or five in number (they are twice as many and half as large in the male). The subgenital plate is deeply divided into two obtuse-triangular lobes that extend to rearward about one-sixth of the length of the sternum of the 9th segment. The caudal stylets are slightly shorter than the 10th segment.

Holotype.—Male; "Kabelstation, bank of Suriname River near bush-negro village, Birioedoematoe; 24 IX '38; (Geijskes)."

Allotype.—Female; Mapaoni River, upper Jari (Brazilian border); Geijskes' No. 20; 9 XI '40; (Schmidt).

Paratypes.—Three males: Geijskes' No. 17, (darker in general coloration), Litani River near Alama Creek, 30 X '40, (Schmidt). Geijskes' No. 18, Tapanahony River, Godohola-soela, 5 IX '41, (Schmidt). Geijskes' No. 19, Paroe River, Upper part (Brazilian border), 3 I '41, (Schmidt).

Holotype and allotype are in the Cornell University Collection; one paratype is in the collection of The Academy of Natural Sciences of Philadelphia.

THE NYMPH (supposition) measures in length 33 mm.; abdomen 24; tenth abdominal segment 8; hind femur 4; width of head 5; of abdomen 6.

This is a smooth clean-skinned nymph with larger and sharper dorsal hooks and lateral spines on the abdomen than are found in any other nymphs of the genus hitherto made known. The antennae are very long and slender, with the sagging third segment not clubbed at all, but parallel-sided and moderately hairy along its edges. The fourth segment is a cylindric rudiment about as long as the third is wide. The mentum of the labium is distinctly widened forward, without offset at its basal hinge. The median lobe is very prominent, semi-elliptical, dished in shape, and rimmed about its front margin by an armature of about twenty-five upcurving, strong, fang-like, sharply pointed scales. The lateral lobe ends in a pronouncedly undulate end hook that is set off from the toothless inner margin by a deep notch.

There are small burrowing hooks on the front tibiae and still smaller ones on the middle tibiae. These tibiae are armed on their upper and lower edges with rows of pedicellate spinules.

The abdomen is of the usual tapered acuminate form, with dorsal hooks and lateral spines large, sharp and thornlike, and strongly pointed to rearward. They are largest on segment 7, diminishing on 8, and to little more than a rudiment on 9. There are lateral spines on 5 to 9; on 5 about half as long as on 6, subequal thereafter, and all outstanding at the sides. The relative length of segments 6 to 10 is about as 11 : 10 : 10 : 10 : 42, with appendages 6 on the same scale.

Described from four exuviae from "Marowijne River, Albina: on sand beach at bank of the river; 7 IX '39." Geijskes' No. 59.

I have risked the supposition that this is the nymph of *Cyclophylla pachystyla* on the slender basis of facts that it is of suitable size, and that it comes from the same country (if not the same locality). It might on that basis be *C. signata* quite as well. Of the six species of *Cyclophylla* nymphs described in my paper of 1940 [36] this species is most like my *Cyclophylla* No. 5 from the state of Ceara, Brazil.

[36] Trans. Amer. Ent. Soc., LXV, pp. 376–380, 1940.

PROGOMPHUS Selys

This genus is represented in the material from Surinam by adults of two species, both of which are new, and by nymphs of two species, to one of which no name can be assigned. All are hereinafter described.

Progomphus brachycnemis new species (Pl. XV, figs. 13*a* and 13*b*.)

Three venational features distinguish this species from the one next to be described. (1) In the forewing there is a single row of cells (paranals) behind the anal vein. (2) In the hind wing the postanal row of cells starts at the hind angle of the triangle and not half a cell length proximal to it. (3) In the hind wing the front side of the two-celled subtriangle is sagged and almost angulated at its conjunction with the dividing crossvein. In points (1) and (3) it is like *pygmaeus* and differs from *risi,* as shown by Williamson's figures of these two species.

Length 31 mm.; abdomen 24; hind wing 19.

Female (teneral). Face brownish, a little paler across the rounded frons, without definite color pattern (or else the pattern is undeveloped), sparsely beset on all its prominences with stiff erect bristle-like hairs. Antennae and vertex brown; occiput yellowish straight-edged, with a marginal fringe of hairs that are about as long as its own middorsal line is. The lateral ocelli are nearer to the median one than they are to the compound eyes, and behind each of them is a low swelling edged with a few erect hairs.

Prothorax obscure. The synthorax is brown in front, overlaid by three transverse crescents of pale yellowish color. The first is a broad crescent covering half the front, convex to rearward and narrowly divided medially by the brown lower end of the carina. The ends of this pale crescent rest on the ends of the collar. The other two crescents are a pair, more laterally placed underneath the ends of the crest, each arching outward into the brown, and dilated there in the position of the upper end of the usual pale antehumeral stripe.

On the side of the synthorax there is a broad uniform chalky white stripe covering most of the mesepimeron, prolonged and narrowed downward between middle and hind legs at its rear margin. On the metepisternum there is suggestion of chalkiness toward both upper and lower ends; most of the metepimeron is chalky greenish white.

Wings hyaline, with brown veins and stigma: Ante- and postnodals 13:10/9:9 in fore and hind wings respectively: fifth antenodal thickened: basal subnodal crossvein present: all triangles and subtriangles two-celled with two rows following, and with an extra initial cell at the hind angle of the triangle in the hind wing but with none in the fore wing. The front side of the triangle is a little shorter than the inner side in the fore wing, a little

longer in the hind. The outer side of the triangle is distinctly angulate in both fore and hind wings. Vein A2 arises at or a little before the middle of the subtriangle in the hind wing, and veins A2 and A3 run out parallel to each other to the hind margin. The three postanal cells are preceded by other rows of three between the branches of the anal vein.

The legs are pale at base and blackish toward the knees and beyond, with the yellowish black-tipped claws. On the hind femur there is an outer row of ten short, thick spines, that gradually lengthen, with two or three of the shorter ones near the base a little out of alignment; and on the hind tibia are eight much longer spines, closer together and more aslant. The hind tibia is somewhat shorter than the hind tarsus with its claw; a little longer than the same without the claw.

The abdomen is mostly brown, but there is a pale chalky cross band covering the basal two-fifths of the dorsum of segment 2, and a pair of large quadrangular spots cover the basal third of the dorsum of 7. There is a break in the ring of denticles at the end of each of the long abdominal segments, where, on the middorsal line, a jog is formed in the ring by several enlarged denticles set forward a little out of line. These aberrant denticles rise highest on segments 7 to 9. The caudal appendages are short, blunt and yellowish in color. They are blunt tipped and hairy externally. There is no tubercle of any sort on the under side of segment 1. On abdominal segments 3 to 5 there are closely crowded, microscopically fine, cross corrugations of the cuticle in two bands, one before and one behind a more deeply impressed cross groove. The short subgenital plate is deeply divided by an open U-shaped emargination, and each of its rounded divisions has a narrow supporting piece projecting equally to rearward at its outer side (much as shown in Williamson's figure for *P. pygmaeus*).[37]

Holotype.—A single female specimen taken by Dr. Geijskes at transformation on a sandy beach at Kabelstation on the Surinam River, August 25th, 1938, now in the Cornell University Collection.

Included in this same lot of material was a fragment of a teneral male that was neither numbered nor included in Dr. Geijskes' list. By careful relaxing and spreading I got a good pair of wings, but genitalia are lacking. The size is near enough—just a little smaller—and the venation agrees except in such minor characters as the occurrence of an extra cell in the paranal row of the fore wing.

Nymphs and exuviae taken at the same spot three days later furnish adequate material for description, and are my justification for naming a new species on so slender a basis of adult material. The description which follows is based on that material, some of which was well enough preserved to show the wing venation.

[37] Occ. Pap. Mus. Zool. Univ. Mich., no. 77, p. 9, pl. 3, fig. 14, 1920.

THE NYMPH measures in length 16 mm.; abdomen 9; hind femur 2; claws of hind tarsus 2; caudal appendages 3; width of head 3; of abdomen 4.

This is a stream-lined nymph, with prominent antennae, strongly divergent wing cases, and acuminately pointed abdomen. The head is flat above and wedge-shaped toward the front, most prominent laterally across the eyes. The eyes are very black, and roughly triangular in outline when viewed from above. The antennae are long, especially the third segment, which is densely clothed with brown bristles. The fourth segment is exceptionally long, about half as long as the third, slender, naked, and reflexed upward.

The labium is very narrow and flat; mentum very slightly narrowed toward its basal hinge, and with almost no sign of the usual contraction to meet that hinge. Its median lobe is prominently rounded, and bears an unusual marginal fringe of about twelve very long bristles each of which is flat, regularly tapered base to tip, and transparent. Each of these bristles is set in a broad flat transparent basal scale that is wider than long and transparent. The tips of the whole row of bristles extend forward underneath the lateral lobes. The end of the lateral lobe is not hooked at all, but bluntly rounded. The movable hook is short, hardly longer than the individual bristles of median lobe, and at its base externally are one or two very long strong setae, about as long as the hook itself.

The thorax is broadly depressed, somewhat shield-shaped with an outrolled and flattened-down, bristle-fringed plate, projecting like eaves, on each side of the three segments. The front and middle legs are extremely twisted and densely covered externally with brushes of stiff brown hairs that lengthen toward the outer and rear margins. The hind legs are short, especially the hind tibiae,[88] which are shorter than the tarsi they bear, even without their tarsal claws. Each tibia, on its rear margin, bears a conspicuous brush of long blackish hair. The hind claws are long and transparent and arcuate; each is notched underneath its tip, and from the outer angle produced by the notch there springs a single long, curved, hyaline bristle, as long as the contracted portion of the tip and in curvature opposed to it. The claws of the fore and middle tarsi are shortened and thickened and unequal in size and the lower one in each pair is armed with bristles. The wing cases reach the middle of the fourth abdominal segment.

The abdomen shows something of a color pattern, varying greatly, however, in depth of pigmentation in different individuals. It is a pattern composed of spottings of brown, that cluster in a midlateral belt along each side of the dorsum, with two faint parallel longitudinal rows of dots intervening. All deepen in pigmentation and condense to rearward into two crossbands of brown of variable depth. One band is laid across the 6th segment and the other, across the basal fourth of the caudal appendages.

In form the abdomen is smooth, lanceolate and long-pointed. There are sharp lateral spines on segments 4 to 9, that increase in size to rearward as far as the 7th segment. There are dorsal hooks of nearly equal height on 1 to 9; on 1 thin, flat, and pale, and not always sharply pointed; on 2, similar but with a better point; on 3 to 9 less flattened laterally, but with longer

[88] Whence, the specific name, *brachycnemis*.

points that reach farther to rearward on successive segments. The caudal appendages are remarkably long and slender, longer than the three end segments taken together. Superiors and inferiors of equal length, thinly fringed with fine hairs along their opposed edges. The laterals are only about one-fifth as long. A pair of round bosses appear on the superior appendage of the male opposite the tips of the laterals.

This nymph is remarkable for the armature of its labium, for the brevity and bushy-hariness of its hind tibiae, for the unusually long fourth segment of its antennae, and for the length and sharpness of its caudal spines. This last character, however, is repeated in the species next to be described.[39]

Progomphus geijskesi new species (Pl. XV, fig. 14.)

This species, though similar in stature and in general dullness of coloration to *P. brachycnemis,* is readily distinguished by the blackness of its abdomen; by the presence of extra paranal cells in the fore wing; by having two rows of cells behind vein Cu2, by having narrower triangles and subtriangles, and lack of a dividing crossvein in the subtriangle of the hind wing; by widely separated ocelli; by the spination of hind femora; and still more, by the curious welt on the under side of the basal segment of the abdomen. The front side of the fore wing triangle is about a fifth shorter than the inner side; about a tenth shorter in *brachycnemis.* Veins A2 and A3 are strongly convergent to the hind wing margin; they are parallel in *brachycnemis.*

Length 33 mm.; abdomen 26; hind wing 20.

Female. This is a slender brownish species, broadly marked with greenish yellow, and overlaid in some areas with chalky greenish white. The sparsely hairy face is brownish except for two chalky cross-stripes, one on the clypeus and the other across the top of the frons. The vertex is black; antennae brown with a narrow pale ring around the base; occiput pale, with a touch of brown on the sharply acute outer corners, its straight upper margin thinly fringed with brownish hairs. The ocelli stand widely apart, the laterals being much closer to the eye than to each other. The ommatidia of the upper surface of the compound eye are nearly twice as large as in *P. brachycnemis.*

The prothorax is obscure in coloration, its middle lobe swollen, bilobed middorsally and bi-flated, somewhat resembling in appearance two sausage links attached end to end. The synthorax is brown in front with a yellow,

[39] For comparative data see the table in my Progomphus life history paper in these Transactions, LXVII, p. 241, 1941.

medially interrupted collar. Confluent with the outer ends of the collar band are two broad, abbreviated, quadrangular, frontal stripes, each distant from the brown carina by about half its own width. Each of these stripes is slightly widened forward, and each is prolonged at its upper outer corner into a sharp point that does not reach the crest. There is no antehumeral pale stripe. On the sides of the synthorax there are three ill-defined, full-length, pale stripes on the three pleurites, well within the borders on each. The third (met-epimeral) of these is much the widest. The yellow of all these pale areas is greenish, more or less overlaid with a wash of chalky greenish white.

The legs are slender, pale to the knees, and beyond that entirely black. The tooth on the tarsal claws is remote from the tip and sharply turned (almost recurved) downward. On the hind femora the short spines on the outer row are subequal, about twenty in number, the last one which is about twice as long as the others; and their length is about half the diameter of the femur. The comb on the front tibia is composed of seven flattened, ridged, and scale-like overlapping spines.

The wings are hyaline, with brown veins including costa and stigma; nodal crossveins 12:8/10:9 in fore and hind wings respectively, with the first and fifth antenodals thickened; basal subcostal present; stigma braced, with four additional crossveins behind it; middle fork slightly but distinctly askew forward. The triangles are slightly four-sided with the front side a little broken near the outer corner, more broken in the fore wing, two-celled in both fore and hind wings. The outer side is distinctly angulated, more strongly in the hind wing. The subtriangles are narrow, the front side being short and straight; they are two-celled in the fore wing and one-celled in the hind. Paranal cells in the fore wing seven, with an added two cells for a second row. There are two cells rows behind vein Cu2. In the hind wing there are three postanal cells, and three other parallel rows of three cells each in the basal anal area.

The abdomen is slender, very little widened toward the ends; all black except the sides of the two basal segments. The first segment is pale except for a transverse blackish dorsal band that is thinly beset with long hairs. On the sternum of this segment there is a transverse welt-like fold or flattened tubercle having at its crest on the midventral line a distinct flap, clothed with stiff hairs that increase in size and stiffness and backward-curvature to rearward. Segment 2 is yellowish and mostly bare. Segment 3 is darker dorsally and on the smoothly tapering apical half. The remainder of the abdomen is black. The relative length of the last four abdominal segments is as 30:18:10:8, with the acutely tipped caudal appendages 9 on the same scale. The subgenital plate is a little recessed in the apex of the 8th segment and divided by a V-shaped notch into two rounded lobes which overlap a little on the sternum of 9.

Holotype.—An adult female from Surinam bearing the data; "Paleumeu River, 20–VII–1941; (Schmidt)," and now in the Cornell University Collection.

Progomphus sp? No. 15 (Pl. XV, figs. 15*a* and 15*b*.)

The nymph here described may possibly be that of *Progomphus polygonus* reported by Selys [40] from Venezuela, a species known to me only from the original description. The measurements given in that description, "abdomen 31, hind wing 31 mm.," are probably in error, since other species in this genus have the abdomen considerably longer than the hind wing. Assuming that the measurement for the wing is correctly given, the size of the nymph is in agreement with such a supposition, and the locality, Venezuela, is near enough. The single specimen before me being a cast skin left behind at transformation, there is no venational evidence available as to its identity.

Length 28 mm.; abdomen 21 (including caudal appendages, 5); hind femur 4; width of head 5; of abdomen 6.

This clean and dainty skin has retained the color markings of the abdomen to an unusual degree for a Gomphine, but only on the dorsum of the abdomen. There is a pair of obliquely divergent dashes at the base of each of the dorsal hooks on segments 2 to 9, and there are two additional rows of smaller roundish spots farther down on the sides of 4 to 9. Segment 10 is wholly suffused with brown, more deeply on the sides. The pale caudal appendages are touched with blackish on their bases and extreme tips.

The body is of the usual subcylindric form, but with an unusually elongate and tapering abdomen. Burrowing hooks are practically wanting from the fore and middle tibiae. The third segment of the antennae is hairy all over its dorsal side as well as on the edges, and somewhat flattened-cylindric in form; the fourth segment is cylindric and pointed and nearly as long as the third is wide. The labium is short and narrow, with its mentum distinctly widened from the tip nearly to the basal hinge. The prominently rounded middle lobe of the mentum occupies less than a third of the front border. The portion of the lateral lobe beyond the base of its movable hook is short and very blunt, not hooked at all, and its inner margin is not toothed. The "epaulets" of the prothorax, that in this genus overhang the concavity of the sides, are very large. The wing-cases are very divergent, and leave exposed the entire series of middorsal hooks, and their tips reach backward barely to segment 5 of the abdomen. Both dorsal hooks and lateral spines are long, straight, thorn-like, and strongly inclined to rearward. The hooks are present on segments 1 to 9, increasing rapidly on the three basal segments and very slowly thereafter to the end. Lateral spines are well developed on 4 to 9 with a distinct rudiment on 3. They increase very slowly in length to rearward and are outstanding on 4 to 8; the one on 9 is smaller, lies close against the body of the segment and at a slightly lower level than the others.

[40] C. R. Soc. Ent. Belg., XXII, p. lxviii, 1879.

The caudal appendages are of remarkable length and slenderness; the superior and the inferiors are long-acuminate. Segments 7 and 8 are almost as long as 9, which is a little longer than 10, and is almost as long as the superior appendage, much longer than the laterals, and one-third as long as the inferiors. It is very distinct by these latter characters from all the nymphs of *Progomphus* hitherto made known.

A single exuvia; "Kabel Station, Suriname River; September 21–28th, 1938; found on a plant stem"; No. 50 of Dr. Geijskes' list; now in the Cornell University Collection.

This species exhibits the extreme of the Progomphus line of nymphal specialization the main features of which I pointed out in my paper of 1941: subcylindric form; small and narrow labium, with blunt-tipped lateral lobe; indrawn middle coxae, with the resulting outer concavity of the sides of the mesothorax overarched by roof-like shoulder plates on the expanded prothoracic dorsum; sand brushes on the outer face of the long joints of the fore and middle legs; front tibiae especially flattened on the bare inner side and fitted to the contour of the side of the head against which they are closely appressed.

Nymphs of the two species hereinbefore described are the slenderest, the shortest legged, and the longest spined Progomphus nymphs hitherto made known.

DESMOGOMPHUS Williamson [41]

This genus is known as an adult from two male specimens that Williamson collected near Tumatumari, British Guiana, along with an exuvia from the same place that I described in my *Progomphus* paper.[42] Two additional male specimens have come to hand, one from Surinam by Dr. Geijskes (along with several exuviae); and one from British Guiana, sent to me by the late Dr. J. G. Myers. All appear to be referable to the species *D. trigrivensis* Williamson. The specific localities in Surinam are, for the adult, "Waremapansoela 30 IX 1939"; and for the exuviae, "Bank of Surinam River near Gansee, on roots of a tree, 26 IX, 1938." The new locality in British Guiana from which comes Dr. Myer's specimen, is "Upper Ireng River, Pakaraima mountains, No. 3005, 1932."

The nymph is superficially very similar to that of *Gomphoides bifasciatus,* but is slenderer, and it is at once distinguishable by a

[41] Occ. Pap. Mus. Zool. Univ. Mich., no. 80, pp. 1–11, 1920.
[42] Trans. Amer. Ent. Soc., LXVII, p. 242, 1941.

glance at the labium. On closer inspection of the abdomen, where the resemblance is most striking, the following minor differences are seen: in *Desmogomphus* the lateral caudal appendages are about as long as the superiors and about as long as the 10th abdominal segment, while in *G. bifasciatus* they are less than three-fourths as long; in *Desmogomphus* the dorsal hooks are suddenly enlarged on the 8th and 9th segments, while in *G. bifasciatus* their increase in size to rearward is gradual.

MITRAGOMPHUS[48] new genus

This genus approaches *Zonophora* in lack of a basal subcostal crossvein, in weak development of vein A2 and of the anal loop, in having a strong spine on the subalar carina just before the base of the hind wing, and in general conformation of triangles and area about the stigma. It approaches *Progomphus* in the general form of the caudal appendages, in slenderness of the male abdomen, and in special development of the sternum of the first abdominal segment. Veins M3 and M4 are more undulate than in any of the allied genera, and the color pattern is strikingly different from all. The blunt-tipped second hamule of the male is also unique, as are the enlarged spines under the hind femur.

Allied to *Zonophora*. Male with a very slender abdomen; two conical spines arising behind the lateral ocelli on the vertex; basal subcostal crossvein present; first and seventh antenodal crossveins thickened; sectors of the arculus arising separately and then becoming contiguous; both triangle and subtriangle of the fore wing three-celled and of about equal size and form; triangle of hind wing two-celled and larger than the one-celled subtriangle; crossveins present in the supertriangular space in both fore and hind wings; three extra cubito-anal crossveins present in the fore wing and two in the hind wing; two rows of cells in the space beyond the triangle in both wings, with two extra initial cells at the triangle in the fore wing and one in the hind wing; veins M3 and M4 undulate in their middle course and their tips turned sharply to rearward to meet the wing margin; brace vein to the stigma undeveloped; stigma distinctly widened distally for three-fifths of its length; vein A2 weak and zig-zag; an ill-defined anal loop of four or five cells; postanal cells five, male anal triangle does not reach to the hind angle of the wing, and is divided into five cells. There are a few greatly enlarged spines in the outer row on the hind femur in the distal third of its length. There are no leaf-like expansions of the eighth and ninth abdominal segments. The caudal appendages of the male are straight

[48] *Mitra,* a head dress rising in two peaks.

and parallel, the superiors tapering to long points, the inferior not half as long, its branches upturned at the end, not wider spread than are the superiors.

GENOTYPE: The following species:

Mitragomphus ganzanus new species (Pl. XVI, figs. 16*a*, 16*b*, 16*c*.)

Length 61 mm.; abdomen 45; hind wing 38; stigma 6.

This is a handsome black species, conspicuously marked with six pairs of spots, three in front and three to rearward. The front ones are yellow; one pair on the frons, one on the collar, and one (the usual oblique pair) on the front of the synthorax. The rearward ones are white, and are all basal on the slender 3d, 4th and 5th segments of the abdomen. The under side of head and mouth parts is tawny, especially the entire labium, the "elbows" of the maxillae and the outer sides of the mandibles; the stiff hairs clothing them are also tawny. The face is black; the labrum with a pair of yellow spots, and a fringe of tawny hair. The anteclypeus is yellow, as are also the facial lobes of the postclypeus. The large yellow pair of spots on the frons covers about equal areas before and behind the sharp superior transverse carina. The top of the head is all black except for very narrow rings about the base of the antennae. The ocelli are rather wide apart. A large acute conical process rises behind each lateral ocellus, and behind this pair of cones there is a low cross wrinkled area extending from eye to eye. The nearly straight sharp edge of the occiput bears a very short fringe of soft hairs.

The prothorax is black above. The synthorax is black with yellow spots in front as above mentioned, and with yellow stripes on the sides. The paired spots on the collar stand well apart at conjunction with the black carina; the obliquely placed pair is higher up and well isolated at both ends. The side stripes are three, and occupy the three lateral pleurites; the first on the mesepimeron is longest; that on the metepisternum is reduced to a little spot at each end; the third irregularly oval one occupies the greater part of the metepimeron; all are isolated by black both above and below.

The legs are black beyond the base of the femora, save for a streak of yellow underneath the front pair, but there are spots of the same color on the short basal leg segments. The spines of the outer row on the hind femur are short and subequal for two-thirds of its length; greatly enlarged and reduced to four or five unequal ones in the remaining third, the third spine from the end being longest.

The wings are hyaline with black veins, including costa and stigma, and with a wash of blackish brown in the membrane at the base, out to the arculus, and rearward to cover the base of vein Cu. Nodal crossveins 19:15/13:16 in fore and hind wing respectively; intermedian crossveins 9/5; paranals of the fore wing, at base two single cells, then two rows out to the base of vein A1; no brace vein to the stigma (though a crossvein touches the inner corner in one wing) and there are about seven additional crossveins under the stigma.

The abdomen is moderately enlarged on the basal segments, and again on segments 7 to 9, while 3 to 6 are very slender (which slenderness, together with the white spots, gives it something of the aspect of the abdomen of *Macrothemis celeno*). Segments 7 to 9 are strongly compressed laterally, twice as high as wide, sharply carinate middorsally, and entirely lacking in leaf-like lateral expansions. The middorsal ridge rises posteriorly to end in a little fork that is made out of two enlarged denticles of the apical transverse carina of the segment, and these rise highest on 9. Segment 10 is rounded above, with only a trace of middorsal carina on its apical third. The four end segments of the abdomen are in length 18 : 13 : 10 : 9, with the superior appendages 18, on the same scale of length. Segment 10 narrows downward at the sides to less than half the length below that it has on the dorsum.

The abdomen is black except for the sides of the two basal segments and the small paired spots of the dorsum; genitalia, also black both at front and rear. Segment 1 has a faint yellow posterior edging on the dorsum, and adjacent to it is a small indistinct basal triangle on segment 2. The sides of 1 are about half occupied by a bright yellow band that extends on 2 only to cover and include the yellow auricle. The auricle is flattened and truncate, with bare and smooth edges except for one or two very minute denticles on the inner angle of the truncate margin. The conspicuous white spots on the dorsum of 3, 4 and 5 are represented by other inconspicuous pairs of similarly placed minute spots on 6 and 7, and by a pair of narrow tawny bars on the sides of 8. Segments 9, 10 and the appendages are black. On the ventral side of segment 1 there is a large conic-triangular prominence strongly inclined to rearward, whose surface is densely beset with coarse prickles. Its apex underlies the anterior lamina of the black genitals of the second segment. The hamules are not very prominent, and not very easy of observation in the single specimen available, the penis being wholly retracted, and the hamules crowded together. The penis guard ("cuillere" of Hagen) is unusually prominent, polished and shining black. The outer end of the anterior hamule is long and slender and tapers regularly to an incurved end hook. The posterior hamule is a little longer and much thicker, straight, inclined to rearward; triquetral in cross section, and blunt tipped, with a few hairs on the blunt end. It is not hooked at all. The hood ("vesicle") of the penis is strictly and literally hood shaped, not medially cleft in twain, but bulging to rearward like the rear of one's head, and with an uprolled rim above at the front. It is bare and shining and transversely wrinkled behind.

The superior appendages are slender, tapering, parallel, and not forcipate. They bear five minute denticles in a row on the inner side at the tip. They are straight and tapering also in lateral view, with a slight obliquely placed basal flange on the under side of their basal fourth, the flange ending where they are widest, opposite the toothed tips of the inferior appendage. The latter is deeply divided by a U-shaped notch, underneath which lies a slightly projecting, flattened, pale, hairy, rounded median lobe.

Holotype.—A single male specimen [44] from Braganza, Para, Brazil; collected by Miss H. B. Merrill; and now in the United States National Museum.

ZONOPHORA

Little seems to have been added to our knowledge of this genus in recent years. It was proposed by de Selys [45] for a single Brazilian species, *Z. campanulata.* He and Hagen more fully characterized it in the *Monographie des Gomphines.*[46] In 1869 de Selys added two new species from Brazil: *calippus* from Santarem, male and female, and *batesi* from Fonte Boa, male only. In 1920 Campion [47] added two species that greatly extended the known range of the genus both north and south: the handsomely colored small species *spectabilis* from Argentina, male only, and the big *bodkini* from British Guiana, female only. Campion published photographic figures of the wings of both species, and drawings of genitalia.[48] These, together with Hagen's drawings of the male genitalia of *campanulata,* are most helpful.

In the material sent me by Dr. Geijskes from Surinam are two species, one of which, *Z. calippus,* is represented by two males and a female, and the other one, a new species hereinafter described as *Z. surinamensis.* Of the former, this greatly extends the known range.

A cast nymphal skin, sent along with these adults, I refer with some confidence to this genus, while making only a guess as to the species to which it belongs.

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[44] This type specimen, while in my possession as a loan, had a fall that broke off the superior abdominal appendages, before drawings had been made of them. That will explain the lack of the conventional dorsal and lateral views of these appendages, and the offering instead of a view of the inferior appendage from the ventral side. After the fall only one of the superior pair could be found. Two views of that one are shown in plate XVI. The appendage itself, entire, inclosed in a gelatin capsule and pinned alongside the otherwise complete type specimen, has been returned with my profound regrets and apologies to the United States National Museum.

[45] Bull. Acad. Belg., XXI, (2), p. 80, 1854.

[46] Monogr. des Gomphines, p. 233, 1858.

[47] Ann. Mag. Nat. Hist., (9), VI, pp. 136, 138, 1920.

[48] Williamson in that year also briefly recharacterized the genus (Occ. Pap. Mus. Zool. Univ. Mich., no. 80, p. 9, 1920).

[49] Bull. Acad. Belg., XXVIII, p. 199, 1896.

Zonophora calippus Selys [49] (Pl. XVI, figs. 18*a*, 18*b*, 18*c*, 18*f*.)

Two males and a female from "Bovenloop, Coropina Creek, Surinam, 27 IV 1943," agree very well with de Selys' description. I add figures of the appendages and genitalia of the second abdominal segment of the male.

Zonophora batesii Selys [50] (Pl. XVI, fig. 19*a*.)

I have a Brazilian specimen with the outer half of the male superior appendages broken off. The stubs show a low triangular inferior tooth. They are nearly cylindrical and pale in color, and the spread of the branches of the inferior appendage is much wider than they, and about as in *surinamensis,* hereinafter described. I present a figure of the genitalia of the second abdominal segment.

Zonophora surinamensis new species (Pl. XVI, figs. 17*a*, 17*b*.)

This species is nearest *Z. bodkini* Campion. It differs from *Z. campanulata* in having a shorter stigma, fewer antenodal crossveins, a broken crossband of yellow on the labrum, and in lack of both a basal tooth and an internal swelling on the superior appendages of the male. The branches of the inferior appendage are less widely spread apart, and the terminal border between the branches is a little bilobed. It differs from all the species of comparable size in having an extra cubito-anal crossvein in the fore wing while having none in the hind wing. Correlated with this, the triangle seems to be a little more remote from the arculus in the fore wings and a little nearer to it in the hind wings than in any of the other species. It agrees with both *bodkini* and *spectabilis* in having an extra cubito anal crossvein in the fore wing; differs in having one in the hind wing.

It may also be said that the type species *Z. campanulata,* has fewer antenodal crossveins in the fore wing (18) than any of the other species. It has a somewhat longer triangle in the hind wing with a more marked angulation of its outer side, approaching that found in the genus *Hagenius.* Also, *Z. batesii* has the triangle of the hind wing closer to the arculus than any of the other species, its distance being less than half the length of the inner side of the triangle; in the other species more than two-thirds that side.

[50] Bull. Acad. Belg., XXVIII, p. 198, 1869.

Length 68 mm.; abdomen 49 (appendages included); hind wing 48.

This is a large black species handsomely striped with yellow. The face is black with one complete and two interrupted cross stripes. The labrum is black with a medially interrupted crossband of yellow, resolved into two oblong spots. The anteclypeus is yellow at both ends with a median overwash of brown. The postclypeus is black except for the stripe that covers the fronto-clypeal suture. Above this stripe the frons is black except on the upper surface where two widely separated oblong spots of yellow lie near the front. The vertex is black except for a small median yellow spot lying in the shallow trough behind the U-shaped post-ocellar ridge and narrow rings around the ocelli. The tips of the U are hair tufted. The occiput is black, its ridge fringed with brown hair that spreads, parted both ways from the middle line. The labium is yellowish, black-tipped. The outer side of the mandible is bright yellow, with other yellow markings beneath the eye.

The prothorax is black above, with a median twin-spot of yellow, a larger spot at the sides, and far down on the sides a still larger spot that extends upon the front coxa. The front of the synthorax is a rich velvety brownish black with narrow yellow edgings on the carina and sides of the collar, and with an unusually narrow pair of dorsal stripes, that diverge forward, tapering, and end far above the ends of the collar. There is a brighter yellow spot next to the spiracle. Sides of the synthorax with four black stripes, each covering one of the lateral sutures, all conjoined at the far reaches of both ends and all tapering downward. The humeral stripe is widest; the others successively narrower.

The legs are black beyond their short bicolored, basal segments, except for the under side of the front femur and some slight touches of yellow at the knees. The wings are hyaline with black veins, including costa and stigma. The nodal crossveins are 21–24: 14–15/15–16: 14–15 in fore and hind wings respectively. There is no basal subcostal crossvein. There is an extra cubito-anal crossvein in the fore wing, but only the usual two are present in the hind wing. There is a wide anal loop of five cells. The brace-vein of the stigma is strong, and under the stigma are six additional crossveins. The male anal triangle is four-celled. The intermedian crossveins (crossveins between the sectors of the arculus out to the middle fork) are 9/4 in fore and hind wing respectively.

The abdomen is black, shiny and bare on the long slender middle segments; moderately hairy and marked with bright yellow on the wider segments toward both ends. There are broad lateral spots of yellow on segments 1, 2, 3, 7 and 8, with minute roundish ones on 4, 5 and 6 (two on segment 4). On segment 1 the yellow covers most of the sides; on 2 it is U-shaped, with the proximal limb of the U narrowly interrupted by the black of the auricle; on 3 it is a very elongated yellow Z; on 7 it is very large and is cut in halves by very black Z-mark, and on the middorsal line of 7 it is united with its fellow of the opposite side, forming a wide cross band on 8, it is rather small and subquadrangular. Segment 10 is wholly black. On the

dorsum of 1 and 2 between the tall hairs of segment 1 and the shorter hairs of 2, there is a narrow cross stripe of pale yellow. The hairs on the dorsum of 2 are black while around the genital pocket on the ventral side they are white.

The superior appendages of the male on almost as long as segments 9 and 10 together; the inferior is one-fourth shorter, with its fork a little more widely outspread than they. The superiors are yellow, merging into the black of the body in their basal fourth; the inferior is wholly black. The superiors taper rather smoothly all the way out to their tips, with only a trace of thickening on the inside at three-fifths their length. They have no basal inferior tooth. The forcipate tips are rather abruptly curved downward and inward at the end. The branches of the inferior appendage are slender and upcurving to a terminal tooth. The genitalia of segment 2 are very black. The anterior lamina is slightly bilobed on its margin. The slender anterior hamules are low lying and, without dissection, appear as two slender parallel pieces whose overarching tips disappear between the posterior hamules. The latter are large and prominent; stout at base, elbowed at the middle to extend backward in a pair of long, opposed, tapering, sharply incurved hooks. The peduncle of the penis is of equal height. Its truncate hood is strongly inclined to rearward, and channeled deeply on the anterior side.

The infero-lateral margin of the long segments of the abdomen is narrowly edged with pale yellow. On 7 this edging become slightly expanded, darker, and its margin spinulose-serrate; it continues straight and smooth on 8, and is well rounded on 9. There is no leaf-like expansion of segment 7, but as it widens to rearward the edge becomes spinulose-serrate, and set off by a submarginal groove. Segment 10 is about a third shorter on the ventral than on the dorsal side.

Holotype.—A single male specimen; "Matapaoni, Surinam; 9, XI, 1940"; now in the Cornell University Collection.

Zonophora sp? supposition nymph (Pl. XVI, figs. 20*a*, 20*b*.)

Length (exuvia) 41 mm.; abdomen 26; caudal appendages 4; width of head 7; of abdomen 10.

This is a rather short-legged, long-bodied nymph with tapering and upcurving antennae that extend half their length beyond the tip of the bulging labrum. The head is widest across the rear of the eyes. Between the eyes and the bases of the antennae there is a patch of hair. Across the bulging hind angles of the head there is a row of five conspicuous bare scars, the outermost and largest pair of which is invaded from the rear by lines of scurfy pubescence. The anterior margin of the labrum is fringed with stiff brown hairs. The labium is long and strong; its hinge rests snugly against the coxae of the middle legs. The mentum is regularly widened from the hinge forward; the front border of median lobe is straight and fringed with a row of rather short stiff spines. The lateral lobes are short, abruptly

widened at the base, with a strong end hook bearing on its inner margin a straight-edged row of about 9 incurving teeth, that diminish in size proximally. The outermost and largest of these teeth is hook-like, the others becoming merely obliquely truncate. The movable hook is very long and strong, with a slight increase in curvature at mid-length and another just before its tip.

The thorax is little depressed, and has a scurfy hairy ridge running down the rear margin of each of its three segments, with bare hollows lying between the ridges. The legs are rather short, stout, with scanty hair brushes on the outer side, and rather inconspicuous scar lines.

The abdomen is elongate-oval in outline, regularly tapering to the very long caudal appendages. It is widest on the 6th segment and most narrowed to rearward on the 9th, with thin marginal fringes of long hairs on all the segments. There are strong lateral spines, incurved and upcurving on segments 8 and 9, about equal in size, and of a length greater than the middorsal length of the 10th segment; the outer margins of both, scurfy hairy. The relative middorsal length of the last four segments is as 8:9:10:7, with the caudal appendages about 25 on the same scale. Segment 10 is cyindric and about half the basal width of the pyramidal 9th. The appendages are attenuated in their middle portion, upcurving and rather abruptly pointed at the end; the superior is about equal in length to the inferiors, the laterals about two-fifths as long. On the ventral side there is a minute median notch in the apical margin of the 8th segment, between a pair of small tubercles.

There is a single female exuvia, accompanying adults of *Zonophora* but not reared, sent by Dr. Geijskes, bearing the label "Lanary I, 2–IX–1942," and now in the Cornell University Collection.

I have studied the empty wing cases but have not been able to make out from them a single venational character to help toward determination of its place. I determine that it is a *Zonophora* by exclusion. It is unique in its upcurving, almost hooked lateral spines, in having them on segments 8 and 9 only, and in the form of its long cuadal appendages.

Explanation of Figures

Plate XIV

Fig. 1.—*Archaeogomphus nanus* new species. 1*a*, penis; 1*b*, genital hamules; 1*c*, caudal appendages of the male, sideview; 1*d*, same, dorsal view; 1*e*, subgenital plate of female.

Fig. 2.—*Agriogomphus sylvicola* Selys. 2*a*, nymph, dorsal view; 2*b*, nymphal labium.

Fig. 3.—*?Cyanogomphus sp?* Nymph. Skyline and caudal appendages.

Fig. 4.—*Ebegomphus strumens* new species. 4*a*, nymphal abdomen, dorsal view; 4*b*, caudal appendages of the male, side view; 4*c*, genital hamules; 4*d*, subgenital plate of female.

Fig. 5.—*Cacus mungo* Ndm nymph (supposition). 5*a*, dorsal view of abdomen; 5*b*, nymphal labium.

Fig. 6.—*Aphylla cornutifrons* new species. Face of adult female (freehand sketch to show frontal horns).

Fig. 7.—*Aphylla producta* Selys. Nymph (supposition). 7*a*, caudal appendages of nymph in dorsal view; 7*b*, labium.

Plate XV

Fig. 7.—*Aphylla producta* Selys. Nymph (supposition). 7*c*, front tarsus and tip of tibia.

Fig. 8.—*Gomphoides fuliginosus* Selys. 8*a*, end of male abdomen in side view; 8*b*, dorsal view of same; 8*c*, genital hamules as seen from front (greatly enlarged, and long inner process foreshortened); 8*d*, penis; 8*e*, labium of nymph.

Fig. 9.—*Gomphoides undulatus* new species. 9*a*, end of male abdomen in lateral aspect; 9*b*, dorsal view of same; 9*c*, penis; 9*d*, anterior hamules from front; 9*e*, posterior hamule from side (same magnification as 9*d*).

Fig. 10.—*Gomphoides cristatus* new species. 10*a*, end of male abdomen in lateral view; 10*b*, same, in dorsal view; 10*c*, penis.

Fig. 11.—*Cyclophylla pachystylus* new species. 11*a*, end of male abdomen in lateral view; 11*b*, same, dorsal view; 11*c*, penis; 11*d*, hamules from front; also auricle, and hairy welt on edge of genital pocket.

Fig. 12.—*Cyclophylla pachystylus?* Nymphal labium.

Fig. 13.—*Progomphus brachycnemis* new species. 13*a*, nymphal labium; 13*b*, end of abdomen of adult female, from beneath.

Fig. 14.—*Progomphus geyskesi* new species. End of abdomen of adult, female from beneath.

Fig. 15.—*Progomphus sp?* Nymph no. 15. 15*a*, nymphal labium; 15*b*, end of abdomen in dorsal aspect.

Plate XVI

Fig. 4*e*.—*Ebegomphus strumens* new species. Base of hind wing of male showing paranal cells lengthwise and postanal cells crosswise striated; the last paranal cell is also the first postanal. *ac*, anal crossing.

Fig. 8.—*Gomphoides fuliginosus* Selys. 8*f*, lateral spines of the 7th, 8th and 9th abdominal segments of the nymph, dorsal view.

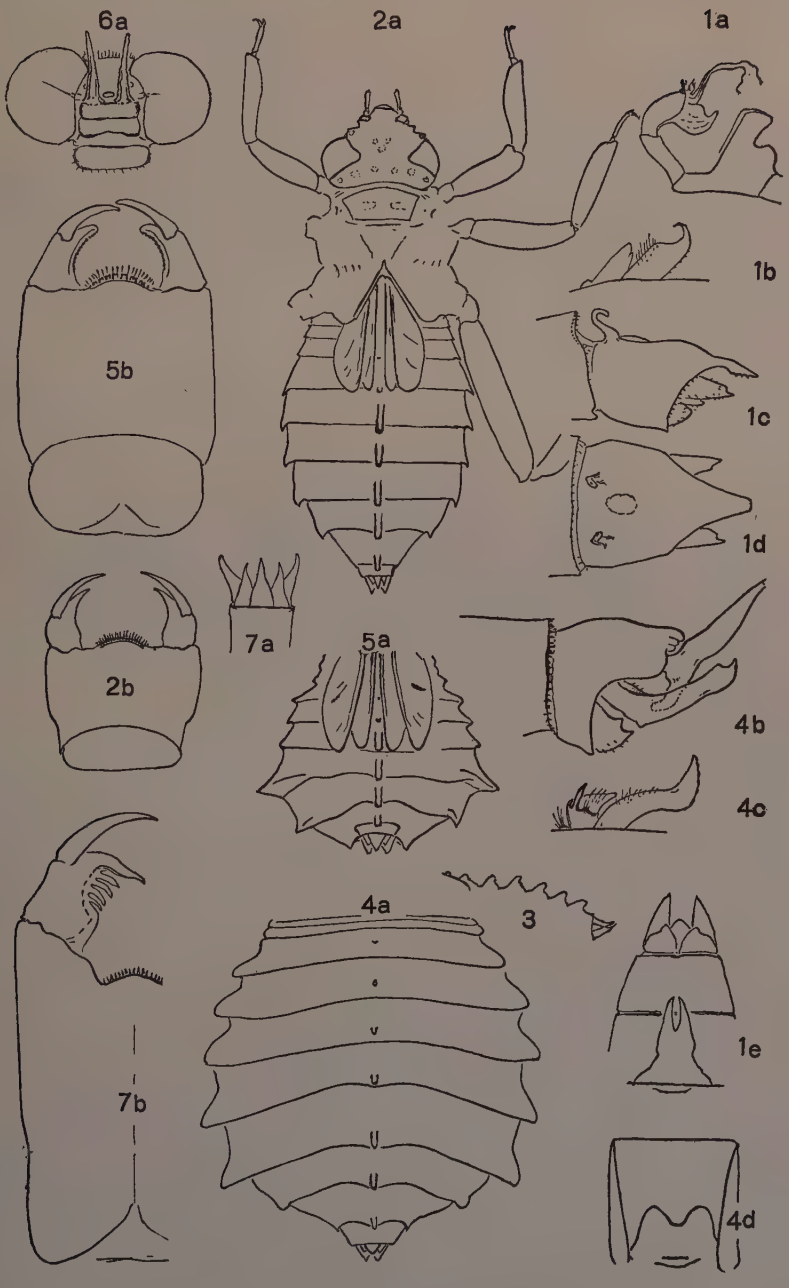
Fig. 16.—*Mitragomphus ganzanus* new species. 16*a*, face view showing the two peaks on the vertex (freehand sketch). 16*b*, two views of the superior male appendage, lateral and dorsal; 16*c*, male inferior appendage, ventral view.

Fig. 17.—*Zonophora surinamensis* new species. 17*a*, male caudal appendages in lateral view; 17*b*, same in dorsal view.

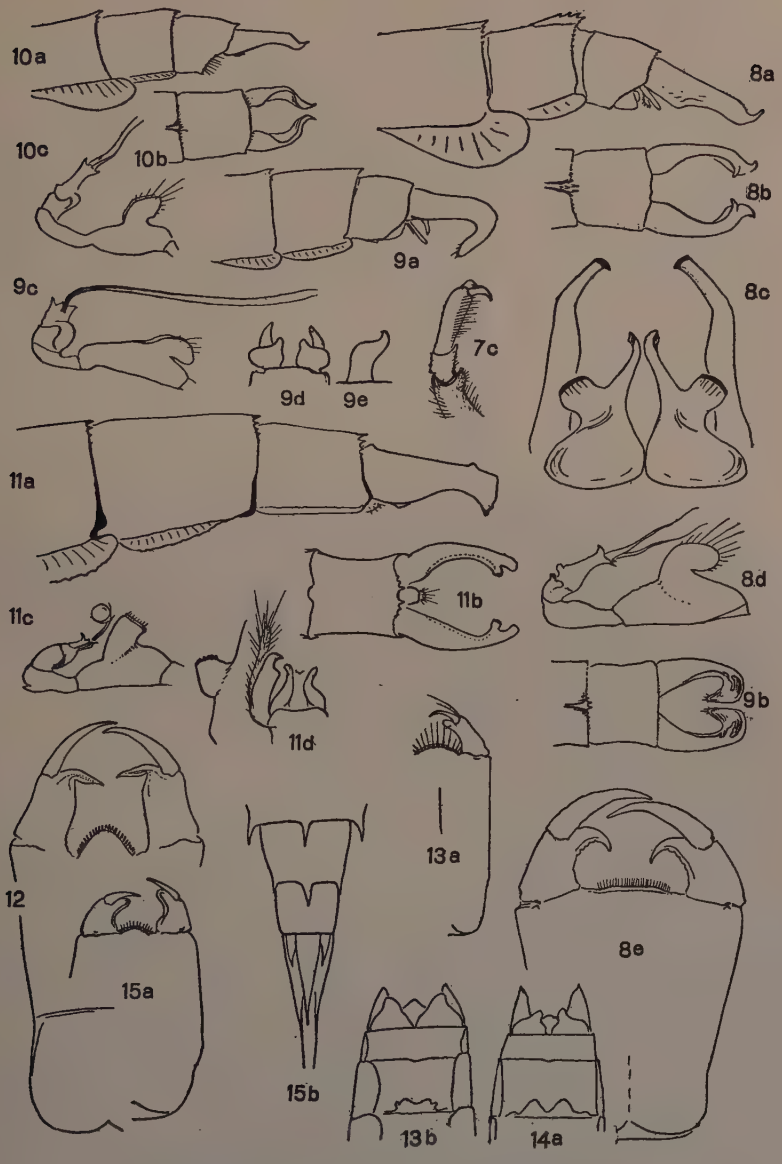
Fig. 18.—*Zonophora calippus* Selys. 18*a*, male caudal appendages in lateral view; 18*b*, same in dorsal view; 18*c*, male hamules, from the side; 18*f*, penis.

Fig. 19*a*.—*Zonophora batesii* Selys. Penis and hamules in lateral view.

Fig. 20.—*Zonophora sp?* Nymph. 20*a*, labium; 20*b*, front tarsus of same, showing also huge burrowing hook of tibia.



NEEDHAM—NEOTROPICAL ODONATA



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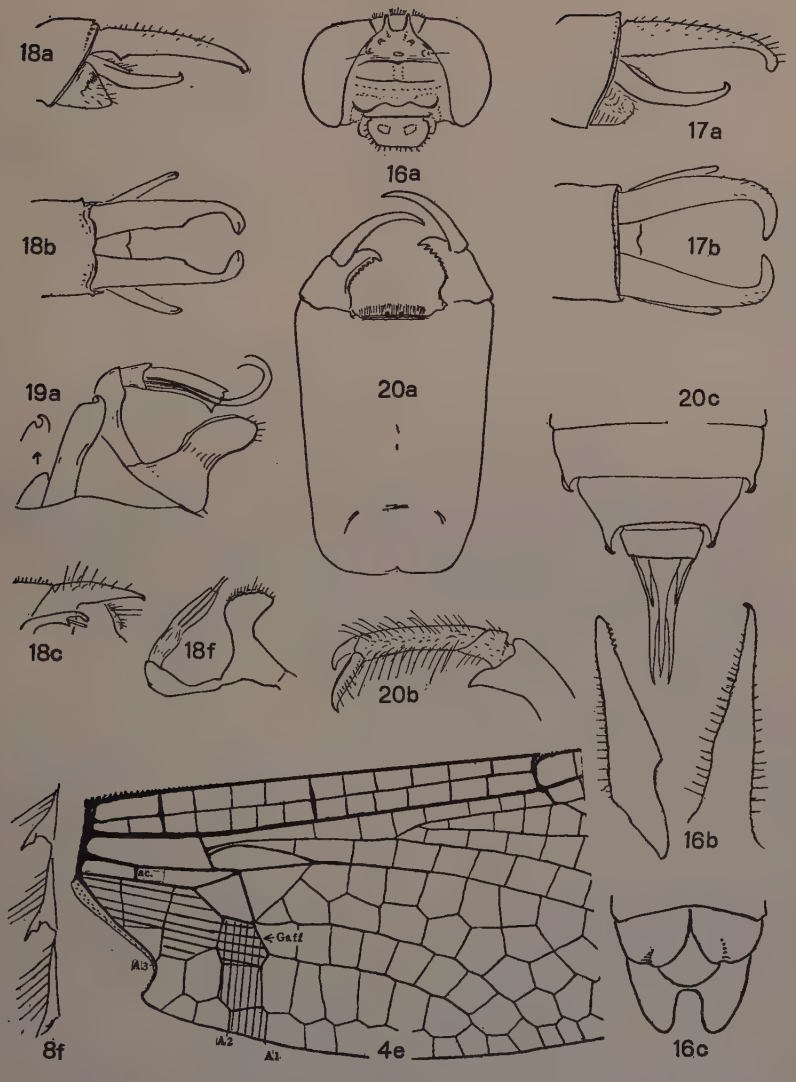

NEEDHAM—NEOTROPICAL ODONATA

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